Pricing System for Means of Production in Industry With Metallurgical Industry as the Example

Jeřzy Borysiewicz

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PRICING SYSTEM FOR MEANS OF PRODUCTION IN INDUSTRY WITH METALLURGICAL INDUSTRY AS THE EXAMPLE

INTRODUCTION

When speaking of the prices of means of production in a socialist economy we refer to the prices observed by the producer and purchaser when transacting the transfer of means of production in a socialist system of society. Accordingly the expression "sale," recurring frequently in this book, is not a perfectly appropriate definition insofar as it pertains to such transactions regarded from the economic point of view. This is because such transactions do not entail that change in ownership which is so characteristic of the sale-purchase act. For this reason, among others, the means of production circulating within a socialist economy are not commodities in the economic sense of the word, even though in practice they are referred to in such terms as "commodity" and "marketable output" and, consequently, "value of marketable output" and "costs of marketable output."

All these definitions, which customarily are used jointly with such definitions as "price," "prime cost," "profit," "turnover tax," and so forth, are related to the utilization of the forms of value in the socialist system of national economy for the purpose of controlling and appraising the performance of enterprises. The utilization of the forms of value and of the law of value (by means of the socialist system of economic accounting) is of vital importance in creating economic incentives for the thriftiest and most rational consumption of means of production and for raising labor productivity. As is known, these are the indispensable prerequisites for the continued growth of the national economy

and for materializing the fundamental economic law of socialism: the law of insuring the maximal satisfaction of the continually increasing material and cultural needs of society as a whole through a ceaseless growth and perfecting of socialist production as based on most modern technology.

Although the means of production circulating within the socialist system are not commodities, their production is indirectly affected by the law of value -- considering the existence of marketable production and of money. This ensues chiefly from the fact that the wages received by the worker must be in a monetary form, because the consumption products necessary for reproducing the expended human labor are, under the present conditions, commodities and as such may be acquired only in exchange for money.

The utilization of the effect exerted by the law of value on production is an essential factor in the performance of the economic accounting system. The outlays of labor and the production costs and results and income and expenditures of socialist enterprises are expressed and measured in the form of monetary value.

"Economic accounting is based on the utilization of the law of value. Economic accounting, by utilizing the monetary form, makes it possible to appraise, audit, and control the activities of enterprises. It reveals the profitability of every individual enterprise. Economic accounting educates enterprise managers in the spirit of rational management, teaches them discipline and instructs them in computing the extent of production properly, raising labor productivity, reducing production costs, and increasing the profitability of their enterprises" (Ekonimia polityczna /Political Economy/, a handbook, Academy of Sciences USSR, Institute

of Economics, issued by the Ksiazka i Wiedza Publishing House, 1955, page 616).

The price as a monetary expression of value is an important factor in the action of economic accounting. This is because enterprises transfer their products to purchasers according to established prices, that is, in the form of an act of sale. The monetary income attained by enterprises is subject to planned division for purposes related to the unfolding of the process of the socialist expanded reproduction. A specific part of such income is assigned for reproducing the expended means of production, that is, for the amortization of machinery, facilities, buildings, etc, and for the purchase of raw and other materials. The remainder constitutes national income, a preponderant part whereof is assigned for paying wages to workers. In this way, among others, through receiving their wages, the workers participate in the division of national income.

The sum total of the monetary expenditures necessary for reproducing the expended means of production, paying wages, and for other expenditures connected with the marketing of products (sales costs) is termed prime cost of realized (sold) production.

The net income of enterprises, or income constituting the difference between the over-all total income from the sales of their products and the prime costs of realized production, is colloquially termed enterprise accumulation. A prevalent part of such accumulation is transferred by enterprises to the state budget, be it in the form of turnover tax (if the prices include such tax) or profit-part payments. The remainder of enterprise profits is assigned mainly for complementing their liquid assets, covering any

unexpected losses, and setting up the so-called plant fund. Inasmuch as the plant fund is designed as a source for financing the collective and individual needs of the employees of labor establishments (needs such as workers' hostels, creches, preschools, excursions, bonuses, etc), every enterprise is interested in maintaining such a fund. This, among others, demonstrates the great importance which a proper pricing level has for the action of the economic accounting system. This stimulates the enterprises to manufacture products whose prices exceed prime costs and which assure the profitability of an enterprise and hence its ability to maintain a plant fund. (As for the loss-planning enterprises, which must sell their products at prices deliberately set below their prime costs, the extent of their plant funds depends on the extent to which they succeed in reducing their costs.)

The importance of a proper determination of prices and the influence of prices on the economic accounting system and its performance are among 2 of the major topics of this book.

Here it would be worthwhile to mention factory prices also, although the concept of factory prices is not a topic of this book. I mention them because whenever the sales prices of means of production do not include turnover tax factory prices usually equal sales prices.

The factory prices determined for the year 1956 have been acknowledged (with a few exceptions) as comparable prices for the years 1956-1960. These prices will be used as the basis on which to estimate the dynamism of the increase in the output of individual branches of industry, the value of planned and fulfilled output, and labor productivity in industrial enterprises.

Heretofore the prices applied for such purposes used to be the so-called fixed prices which in principle were equal to the 1937-1938 prewar prices. However considered from the viewpoint of level and interrelationship these prices have not been commensurate with the present conditions in Poland.

The replacing of fixed prices by comparable prices should yield positive results. It will undoubtedly contribute to strengthening the performance of the sales price system and thereby to strengthening economic accounting and intensifying the efforts purporting to raise the profitability of industrial enterprises.

CHAPTER I. PRICES OF RAW MATERIALS AND SUPPLIES FOR IRON METALLURGY

1. Prices of Ores and Iron-Yielding Materials

Metallurgical value of ores. Ore price level. Determination of ore prices in relation to price of standard ore. Pavlov's formula. Influence of slag basicity on metallurgical value of ores. Methods of computing the value of individual ore components. Prices of (iron-yielding) waste utilized within the plant. Variable nature of metallurgical value and of the price relationship based on it.

Among the problems discussed in this section the paramount one is the problem of determining the proper price relationship, that is, the interrelationship among the prices of the various sorts and grades of raw materials consumed in the manufacture of products that are identical or very similar.

If diverse kinds and grades of a raw material may be used for identical purposes, the relationship of their practical values may be expressed in the equivalent form. In the case of ores such a form is constituted by their metallurgical value. Therefore the relationship among the prices of such raw materials may be termed "equivalent relationship." The main principles of this expression will be discussed in the other parts of this book. The form of equivalent relationship applicable to iron ores is specific but very interesting.

The pricing system for iron ores and iron-yielding materials -- the basic raw materials of the metallurgical industry -- fulfills definite economic tasks in the field of economic accounting in the metallurgy of iron. To understand the mechanism of the performance of this system it is necessary to study at least a rough outline of the characteristic properties of iron ores and the importance of these characteristics for the user -- the metallurgical industry.

Iron ores are minerals containing iron in the form of diverse chemical compounds (mostly oxides) and gangue. The chemical composition of the gangue exercises a considerable influence on the evolution and productivity of the blast furnace process. This composition decides whether a given ore can be melted down with ease or with difficulty, and hence it affects the extent of the consumption of fluxing agents and coke per ton of obtained pig iron and the daily capacity of a blast furnace (volume of output per 24 hours of blast furnace operation) and, consequently, the level of prime costs per ton of pig iron. Moreover the quality of an iron ore is considerably affected by its content of sulfur and phosphorus which, even when present in relatively small quantities, cause (as harmful

admixtures) a reduction in the productivity of the blast furnace process or in the quality of the obtained pig iron. On the other hand the admixture of manganese affects favorably the blast furnace process.

Besides the chemical composition of an ore its degree of comminution, i.e., its granulation or lumpiness, is of major importance to the effectiveness of the blast furnace process. If the furnace charge contains much ore slack this leads to increased ore consumption owing to increased out-blast of blast furnace dust. This in turn affects adversely the level of prime costs. Even in the event that a considerable part of this dust is "caught" by purifying devices, the prime costs of pig iron are bound to increase, because the "caught" blast furnace dust must, after being reprocessed, again undergo the entire technological process.

The influence of the chemical composition and physical form of ore on the productivity of the blast furnace process and the extent of consumption of charge materials, and hence also on the prime costs of the obtained pig iron, is expressed by the concept of the metallurgical value of ore. The greater is the metallurgical value of an ore the smaller quantities of fluxing agents and fuels are consumed by the blast furnace process and, accordingly, the smaller are the corresponding processing costs per ton of obtained pig iron. In other words the process of melting iron out of an ore having a high metallurgical value requires smaller outlays of human and mechanical labor.

Knowledge of these factors is of enormous importance for an economic analysis of the metallurgy of iron. This is because it should be realized that a proper appraisal of the results of performance of a blast furnace on the basis of unit prime cost of pig

iron is possible only upon eliminating the fluctuations occurring in the level of the prime costs of pig iron owing to the variations in the metallurgical values of the diverse ores. Therefore it is necessary to create appropriate relations between the price of a given ore and its metallurgical value. Ore prices should be determined so as to cause the prime costs of the obtained pig iron to remain -- at a uniform efficiency of blast-furnace performance -- on an essentially constant level regardless of the kind, chemical composition, and physical form of the ore used.

Otherwise it would be much more difficult to analyze the prime costs of the blast furnace department and, moreover, the effect of economic accounting on the results of the performance of iron foundries would be greatly weakened. In such a situation the prime costs of pig iron, and hence the profitability of both the blast furnace department and the iron foundry as a whole would be liable to extensive and accidental fluctuations ensuing from the composition of blast furnace charge -- a factor on which but a modicum of influence can be exercised by the foundry management. This is because ore supplies are affected by the raw material situation of a country, that is, by the actual possibilities for extraction of domestic ores and by imports of foreign ores.

The interrelationship of the prices of various kinds and grades of iron ore must, therefore, be a reflection on the metallurgical value of such kinds and grades.

The problem of determining the proper level of iron-ore prices is another factor to be considered, besides the problem of the interrelationship of prices, when drafting a price list for iron ores. From the economic viewpoint considered, this problem is a

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rather complicated one and is connected to the over-all economic policy of the state. In determining the price level due note must be taken not only of the extraction costs of domestic ores but also of the purchase costs of foreign ores. At such an approach to the problem it may be found that, in view of the necessity of maximal utilization of domestic mineral resources, the prices of certain ores have to be set at a level below the actual costs of their extraction, in order -- naturally -- to prevent the rise of the prime costs (and hence also prices) of metallurgical products to a too high and economically unjustified level.

So far practice has shown that the price costs of the extraction of domestic ores stand on variegated levels. In this connection it is characteristic that, as a rule, the mines with lower extraction costs produce iron ores that are mostly of higher quality from the metallurgical viewpoint. For instance the extracting costs of the relatively high-grade basic siderites in the Czestochowa region are considerably below the extracting costs of the less high-grade acidic siderites in the St. Croix Mountains region.

Considering that a sizable part of the iron ores consumed in Polish steel plants derives from imports and that the extracting costs in certain mines of the Czestochowa ore region approximately equal the costs of purchasing foreign ores, the level of iron-ore prices for the year 1956 has been determined on the basis of the level of extracting costs in just these mines. At the same time a general index has been calculated for indicating the ratio of 1956 ore prices to the 1956 price level.

It is clear that the adoption of relatively lowest extraction costs as the basis for determining the price level would result in

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the unprofitability of the iron ore mining industry as a whole. However this must be regarded as an objective necessity ensuing from the fact that iron-ore extraction costs in many domestic mines stand as yet on a much too high level and should not be allowed to affect the costs and prices in the metallurgical industry; the more so as the percentile share of these ores in the whole of the consumed mass (imported and domestic ores) is a minor one.

As is known iron ores occur in various kinds and grades. Therefore decisions concerning the price level cannot either establish closely the weighted average price per ton of ore because such price must vary depending on the actual traits of the ores delivered to metallurgical industry. In practice the composition of the ores consumed by blast furnaces is subject to extensive fluctuations in terms of chemical composition (depending on the origin and many other factors). In these conditions the only price that can be established with any reasonable accuracy is the price of one specific kind of iron ore acknowledged as the standard ore because it is consumed in greater quantities than any other ore. In Poland a certain grade of Krivoi Rog ore may be said to be such an ore.

The determination of either a general price level or the price of the standard ore constitutes merely the point of departure for drafting the prices of individual kinds and grades of iron ores. In this connection it is necessary to consider the interrelationship among the metallurgical values of ores especially in relation to standard ore. However it has to be emphasized that in practice this is not an easy task. True enough the over-all effect of individual ore characteristics (chemical composition and granulation) on the blast-furnace process is generally known, but so far no one

has yet worked out tables of interrelationship among ore characteristics, evolution of blast furnace process, and consumption of fluxing agents and coke. This is probably owing to the fact that there still exist gaps in the theoretical knowledge of the evolution of the blast furnace process. Therefore we encounter with diverse systems for determining the metallurgical value of ores formulated by eminent blast-furnace experts.

In his Metallurgy of Pig Iron the renowned Soviet savant academician M. Pavlov furnishes a method for computing metallurgical value and determining the prices of a specific kind of iron ore (Pavlov, M., Metallurgiya chuguna, press of the Academy of Sciences USSR, third edition, Moscow-Leningrad, 1948, page 170). According to M. Pavlov the cost of the production of one t of pig iron may be expressed by means of the following formula:

$$P = {}_{p}1(f:F) + C_{p}2 + c_{p}3 + g$$

where:

f:F = ratio of iron content of pig iron to iron content of ore, expressing the theoretical magnitude of ore consumption necessary for obtaining a unit (one t) of pig iron

p^1 = price of ore unit (one t)

C = consumption of coke per unit of pig iron

p^2 = price of coke

c = consumption of fluxing agent per unit of cast iron

p^3 = price of fluxing agent

g = processing costs (costs of direct human labor and departmental costs) per unit of production

The price of one t of ore may be obtained upon transposing the formula thus:

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$$_{p}1 = (F:f)\ (P - C_{p}2 - c_{p}3 - g)$$

"The ratio F:f, expressing the theoretical yield of pig iron from ore, may be applied without necessity of correction in the event of comparison of lumpy ores or of ores with identical content of slack; in cases to the contrary due note has to be taken of the difference in losses of iron owing to the out-blast effect" (Ibid, page 170).

The above cited formulas indicate that the computing of the price of a given ore entails a prior determination of the cost of production of pig iron as a constant magnitude serving as the basis for interrelating the prices of diverse kinds and grades of ores. This magnitude should correspond to the cost of producing pig iron from the standard ore, whose price is established when determining the over-all price level for iron ores.

With respect to the other factors of the above formula it has to be stated that, whereas the price of coke or fluxing agent is a known value (it has to be determined prior to formulating the prices of iron ores), the extent of the consumption of coke or fluxing agents ensues from purely empirical postulates. This is easily evident from the sizable divergences in the figures cited by various metallurgists with regard to the interrelationship between the consumption of coke and fluxing agents and the chemical composition of the ores used. The cause of these divergences is the fact that the related measurements were carried out in blast furnaces differing in their designs and containing furnace slag of varying degree of basicity, which is also related to the technological mastering of the operation (performance) of a blast furnace. This is because a smaller degree of basicity involves, on

the one hand, a much smaller consumption of fluxing agents and coke per ton of obtained pig iron and, on the other hand, causes greater difficulty in removing sulfur from the metal bath and entails the danger of exceeding the permissible standard for the content of sulfur in pig iron.

Sulfur which, as is known, causes pig iron to be impure, originates chiefly from coke ash, although in certain cases it may also infiltrate pig iron from the original ore or from a fluxing agent. The transfer of sulfur to slag consists in that it becomes chemically combined with the bases contained in slag, as according to this reaction (Cf. engineer Eugeniusz Mazanek, Obsluga wielkiego pieca /Blast Furnace Servicing/, State Technical Publishing House, 1950, page 256):

$$FeS + CaO = FeO + CaS + 730\ \text{kcal}$$
$$\underline{FeO + C = Fe + CO - 34,460\ \text{kcal}}$$
$$FeS + CaO + C = Fe + CO + CaS - 33,730\ \text{kcal}$$

Next, calcium sulfide, being a lighter substance, floats to the surface and unites with slag. The transfer of sulfur to slag by means of the magnesium oxide (MgO) contained in slag occurs through a similar process.

From the above description it can be clearly concluded why a reduction in the basicity of slag aggravates considerably the desulfurization of pig iron and requires an improved mastering of blast furnace performance.

The Polish blast furnace industry can boast of considerable achievements on this sector. Whereas in the hitherto used price list the relationship among iron ore prices was based on an index

of slag basicity (ratio of CaO + MgO to SiO_2), amounting to 1.3, in the price list for 1956 that index could be already assumed at 1.15. This index affects somewhat (in the postulates of the price list) the magnitude of consumption of coke and fusing agents at the melting of an ore with a specific chemical composition.

The postulates of the iron ore price list for 1956 were based on the following major empirical values necessary for computing the metallurgical value of ores:

(a) consumption of limestone for fluxing into slag 1% of the SiO_2 contained in a ton of ore (or per 10 kg of silicaceous earth) = 22.5 kg;

(b) consumption of coke per ton-percent of silicaceous earth (1% of SiO_2 in a ton of ore) = 10.40 kg;

(c) consumption of coke per ton-percent of Al_2O_3 = 2 kg;

(d) consumption of coke per ton of pig iron for reducing Fe = 750 kg.

The expenditure of ore per ton of pig iron (value "f:F" in the formula of the academician M. Pavlov) hinges on the Fe content of ore, upon considering that allowance must be made for the consumption of a certain amount of Fe in the form of irretrievable losses (cinders and others).

In the 1956 price list postulates the irretrievable losses were determined thus: the consumption of Fe per ton of cast iron was assumed at 1,000 kg, although the actual content of Fe in the iron averages 93%.

In order to compute the metallurgical value and price of an ore according to the academician Pavlov's formula it is necessary to determine an additional factor, namely the cost of processing a

ton of pig iron as related to the given grade of ore. As is known the processing cost per ton of pig iron is inversely proportional to the productivity of the blast furnace with respect to the given grade of ore. According to viewpoints universally accepted among the metallurgists, the turnover of coke is a yardstick for measuring the productivity of a blast furnace (here we shall desist from explaining this thesis, because this would exceed the scope of the book). This thesis leads to yet another conclusion, viz., that the processing cost per ton of pig iron is, in principle, directly proportional to the consumption of coke per ton of pig iron. Hence the value of the "g" in the academician Pavlov's formula may be calculated by the following formula:

$$g = C \times p$$

where: C = quantity of coke consumed for producing the over-all tonnage of pig iron from a given ore;

p = cost of processing a ton of open-hearth pig iron per ton of coke consumed in producing such pig iron out of the standard ore:

$$\frac{\text{total cost of processing a ton of pig iron}}{\text{quantity of coke consumed to produce the over-all tonnage of pig iron}}$$

On the basis of the above described formula of academician Pavlov general principles have been worked out for interrelating the prices of individual grades of iron ore.

However in practice use is made of more precise solutions. Besides the pure iron content (Fe), the silicon dioxide content (SiO_2), and the bases (CaO and MgO), note is also made of the other chemical constituents of ores, such as the content of aluminum compound (Al_2O_3), manganese (Mn), phosphorus (P), and

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sulfur (S). Such solutions are, of course, based on principles similar to those of the Pavlov formula, except that they slightly differ in their details. This is because the first stage is devoted to computing the (monetary) value per ton-percent of every major ore constituent (10 kg per ton of ore), upon taking into account the influence it exerts on the unfolding and effects of the blast furnace process. In the second stage the value of every individual ore is calculated as a sum of the values of their constituents.

These values are explained below.

(1) One percent of SiO_2 in a ton of ore represents -- as according to the postulates for the 1956 price list -- a negative value of 5.60 zlotys.

Explanation. Assuming that the number of free bases in the limestone totals 50.9%, and assuming that 50% of the limestone's composition unites with the slag, it is to be assumed that, at a slag basicity index of 1.15, the quantity of limestone necessary for slagging-up 10 kg of SiO_2 amounts to $10 \times 1.15 \times \frac{100}{50.9} = 11.5 \times 1.97 = 22.5$ kg; in this case the quantity of this slag would amount to $10 + 10 + 22.5 \times \frac{57}{100} = 22.8$ kg. Considering that, according to empirical data, 0.16 kg of coke are consumed per kg of slag, independently of the consumption of 0.30 kg of coke per kg of limestone, the consumption of coke per ton-percent of SiO_2 will amount to $22.8 \times 0.16 + 22.5 \times 0.30$, that is, 10.40 kg.

The price of coke, jointly with the pig iron processing cost per ton of consumed coke (see description of Pavlov's formula), is assumed at 480 zlotys per ton in the postulates for the 1956 price

list. Therefore the negative value of one ton-percent of SiO_2 in the ore will amount to 10.40 kg x 0.480 zlotys/kg + value of consumed limestone (22.5 kg x 0.025 zlotys/kg), i.e., 5.55 zlotys (or roughly 5.60 zlotys).

(2) One percent of Al_2O_3 in a ton of ore has a negative value of 0.96 zlotys, because its slagging-up requires 2 kg of coke (2 kg x 0.480 zlotys/kg = 0.96 zlotys).

(3) One percent of CaO in natural condition (in the form of a carbonate) in a ton of ore has a positive value of 0.75 zlotys, while if in the form of oxides that value amounts to 3.40 zlotys. The same pertains to MgO.

Explanation.

$$\frac{25 + (2.5 \times 5.80) + (0.7 \times 0.96)}{53.80} = 0.75$$

whereas

$$0.75 + (10 \times 0.7 \times 0.786 \times 0.48) = 3.40 \text{ (approximately).}$$

(4) One percent of Mn in a ton of ore has a positive value of 15 zlotys.

(5) One percent of P in a ton of ore has a negative value of 20 zlotys, but this is ignored when computing the prices of the ores with a high phosphorus content used in the production of Thomassian pig iron.

(6) One percent of S in a ton of ore has a negative value of 6.70 zlotys.

(7) One percent of Fe in a ton of ore has a positive value of 6.20 zlotys.

Calculations of the value of 1% of Fe in a ton of ore have been carried out -- similar to those for Mn -- by assuming a definite price of the standard ore and deducting therefrom the value of every individual component.

The determination of the price of a specific ore on the basis of the above cited indexes would be now a very simple task. This is illustrated by the table below, calculating the price of Class 2 Hematite from Krivoi Rog mines.

TABLE 1

Analysis in Dry State	Value of One Ton-Percent in Zlotys	Total Value of Given Ore Component, in Zlotys	
		Positive	Negative
Fe = 60%	6.20	372.00	--
Mn = 0.1%	15.00	1.50	--
$CaO + MgO$ = 1%	0.75	0.75	--
SiO_2 = 10%	5.60	--	56.00
Al_2O_3 = 1.5%	0.96	--	1.44
P = 0.06%	20.00	--	1.20
H_2O = 5%	--	--	--
Dust Content Below 10 mm = 60%	--	--	--
TOTAL		+374.25	-58.64

Hence the price of ore in dry state equals: 374.25 - 58.64 = 315.61 zlotys; and in wet state $315.61 \times \frac{95}{100} = 299.83$ zlotys.

To obtain the price of wet ore, this value must also be reduced by substracting therefrom the cost of breaking and sorting wet ore, which cost is assumed by the price-list postulates as identical (9 zlotys per ton) for all grades of ore, and the cost of sintering

a ton of ore to be identical for all ores and to amount to 35 zlotys/ton. Therefore:

$$299.83 - 9 - \left(\frac{35 \times 60}{100}\right) = 269.83 \text{ zlotys.}$$

Roughly speaking, then, the price of Class 2 Krivoi Rog ore amounts to 270 zlotys per ton.

The above price, based on a closely determined (on the basis of statistical data for a prolonged period of time) chemical composition of every kind of grade and ore, is termed basic price in practice.

If, upon the effecting of an ore delivery, the analysis of the ore shows it not to differ much in price from the price adopted as basic, the related accounting should be made for the basic price. But if the difference is too great the price should be recalculated according to actual chemical composition of the delivered ore upon considering the above cited indexes of monetary value per ton-percent of given ore components.

The prices thus determined do not take into account the actual purchasing costs of foreign imported ores. This is quite right and proper, because the steel plants should be able to operate in uniform conditions regardless of the origin of ores and the circumstances causing the fluctuations of their prices on the world market. Such a kind of accidentality in the evolution of ore prices is excluded by the principle that the price of an ore corresponds to its metallurgical value.

Besides ore, the iron-yielding furnace charge contains a sizable percentage of diverse iron-yielding materials such as blast furnace dust, iron-containing slag from open-hearth furnaces, ingot

scrapings, etc. Such materials are rarely exchanged among the steel plants because they are normally utilized by the plant where they appear. Nonetheless the height of the sales price of iron-yielding materials affects considerably the scope of their utilization in the blast-furnace process. This is because these materials are included in the material costs of pig iron according to their sales prices no matter whether these materials have been purchased outside or utilized on the spot as usable wastes of full-value products. True enough the metallurgy of iron, as in many other branches of industry, observes the principle of "protracted cost" which consists in that the semifinished products manufactured and consumed within a given enterprise are included in further production as according to prime costs, but so far as wastes are concerned it is assumed that their prime costs equal their sales prices. This is of course a purely conventional assumption, made because the cost of wastes may be determined only on a contractual basis in general. The adoption of the sales price of wastes as their contractual prime cost has some sense also because the prime cost of the finished product is reduced by the value of wastes.

When individual production departments strive to improve their efficiency, consumption of wastes may take place only when their price is determined in such a way as to take into account the technological value of wastes and, on the other hand, not to result in lowered efficiency in the event that these wastes are utilized in further production. These requirements are satisfied by including wastes in further production estimates according to sales prices. Of course, the sales price must then correspond to the metallurgical value of these wastes; in any event it cannot exceed that value.

However sales price of certain wastes such as open-hearth slag may be set at a level slightly below their metallurgical value when their chemical composition is particularly difficult to reduce (e.g., iron silicates) or when a slag contains too much phosphorus and thus is difficult to process. The stipulation of the price of open-hearth slag at a level below its metallurgical value counteracts the wholly understandable reluctance of blast-furnace men to use this kind of slag. However it is to be kept in mind that, on the other hand, the pricing of slag at a too low level may somewhat discourage the steel workers from carrying out properly the slag process -- that modern and most economical method of steel-plant operation.

The prices of iron-yielding materials the processing of which does not entail special difficulties (rolling mill wastes, heating slag, etc) should be determined in relation to the prices of iron ores and based on their metallurgical value.

The iron-yielding materials consumed by the blast-furnace process include also steel scrap which has become considerably corroded and which, therefore, is not very suitable for use in the steel-production process. The prices of such scrap should be determined in their relation to, on the one hand, the prices of ordinary steel scrap, and on the other hand, the prices of iron ores, upon taking into account the metallurgical value of the blast-furnace scrap.

However it is to be particularly emphasized that metallurgical value is not a stable concept because its level is affected by diverse and often variable factors such as the price of coke, the method of blast-furnace process operation (among others, basicity

of slag), the type and equipment of blast furnace (which also affects the height of processing costs), and other factors.

If after the elapse of a period of time these factors cause major and irreversible changes in the metallurgical values of ores in relation to the values adopted as the basis for the official price list, the relationship between the prices of iron ores must be reviewed and revised so as to determine the new metallurgical values and then to work out a new price list on their basis. If this is not done there may arise considerable deviations in the evolution of prime costs of cast iron -- deviations caused by improper arrangement of iron-ore prices and not by any changes in the efficiency of the blast-furnace process.

2. Prices of Steel and Iron Scrap and Alloy-Steel Scrap

Equivalent relationship. Index of equivalent relationship. Index of equivalency. Scrap sales prices. Scrap as a commodity. Utilization of the law of value to intensify scrap collection. Role of price in transition from individual to collective scrap collection. Loco and franco prices. Prices of scrap purchased from industrial plants. Prices of alloy steel scrap.

This section will discuss the general principles of equivalent relationship. These may find a wide application not only in the metallurgy of iron or nonferrous metals but also in a number of other branches of industry. The example of scrap will be used to discuss also the price systems incorporating a solution of the problem of taking into account the difference between the economic factors considered when determining scrap purchase prices and those considered in sales prices.

In the production process steel and iron scrap fulfill a role similar to that of pig iron as they are among the major components of the furnace metal charge. Scrap may be supplanted to a certain degree by pig iron and conversely. From the viewpoint of utile value a certain equivalent relationship exists between pig iron and scrap. The relations between the prices of pig iron and scrap and among the prices of diverse kinds of scrap should express this equivalent relationship. The scrap sales prices, and hence the prices according to which scrap is included in the prime costs of production, should be based on a relationship which may be termed equivalent and expressed by the following formula:

$$\frac{P}{P_c \times Q} = S_e$$

where:

S_e = index of equivalent relationship;

P_c = basis of relationship (price of basic product on which the determination of relationship is based, in the case of scrap -- price of standard pig iron having a specific chemical composition);

Q = index of equivalency (expressing the ratio of utile values in the process of production or consumption, as counted in natural units, between 2 commodities -- the basic commodity and the one whose price is to be computed from equivalent relationship; in the case of scrap this concerns metallurgical value of one t of scrap in relation to one t of pig iron;

P = price of commodity calculated from equivalent relationship.

The index of equivalent relationship (S_e) hinges also on the postulates adopted for a given stage of the economic development of the country. This is because the level of that index decides whether

and to what degree is it profitable to replace a material with another; thus this is one of the economic incentives affecting a reduction in the consumption of scarce materials. Up till 1955, inclusively, the contractually accepted index for steel and iron scrap was set at 0.7. In practice this has proved incorrect because the scrap prices fixed at an index of equivalency amounting to 0.7 tended to obscure the results of steel-plant operation. Owing to their replacing pig iron with scrap the steel plants could show on paper a reduction in their prime costs although actually no real economic accomplishments had been made. Such a pricing arrangement could not naturally encourage a thrifty utilization of scrap in steel plants especially when bonuses were paid for reductions in prime costs.

In view of the limited opportunities for scrap utilization the pricing system should create conditions favorable to increasing the percentage of pig iron in furnace metal charge and decreasing correspondingly the percentage of scrap. Therefore the index of equivalent relationship adopted in the 1956 price list amounts to 1.0.

If the new system of pig iron and scrap prices results in an increase in the ratio of pig iron to scrap in the metal charges of any steel plant this will not entail any increase in prime costs, and neither will any such increase be entailed in the event that this ratio decreases.

It is not out of question that in the future economic considerations may cause the index of equivalent relationship to be fixed at a level exceeding 1.0. This would signify the creation of a strong economic incentive (regardless of the bonuses paid for

reduction in costs) for increasing the ratio of pig iron to scrap in furnace metal charges, that is, for the thriftiest possible consumption of scrap in the production process.

When the values of S_e and P_c are known, it becomes very simple to determine the height of the sales prices of various kinds and grades of nonalloy steel scrap. This is achieved by transposing the formula:

$$\frac{P}{P_c \times Q} = S_e$$

into:

$$P = S_e \; (P_c \times Q)$$

Therefore the prices of various kinds and grades of nonalloy steel scrap are calculated according to these formulas:

$$P_1 = S_e \; (P_c \times Q_1)$$
$$P_2 = S_e \; (P_c \times Q_2)$$
$$P_3 = S_e \; (P_c \times Q_3)$$
$$P_4 = S_e \; (P_c \times Q_4), \text{ etc}$$

where the numerals 1, 2, 3, 4, etc, are used to denote individual kinds of scrap and their corresponding indexes of equivalency.

In the postulates for the price list of nonalloy steel scrap (for the year 1956) the value of P_c was assumed to equal the price of open-hearth furnace pig iron Grade M1, Variety 1 (containing 1.3% of Mn), with a S content of 0.05%, i.e., a price of 1,100 zlotys per ton.

The fixing of the index of equivalency of steel scrap is relatively easy because it is based on Polish Standards and Measures which postulate the "relative utile value of scrap" (according to Standard PN/H-15000).

For instance let us assume that a given kind of scrap has a "relative utile value" of 50% according to Polish Standards and Measurements; therefore the "Q" index will amount to 0.5.

Assuming the "S_e" index at 1.0 and the "P_c" value at 1,100 zlotys per ton, the sales price of that scrap will be:

$$P = 1.0\ (1{,}100 \times 0.5) \text{ zlotys per ton,}$$

$$P = 550 \text{ zlotys per ton.}$$

What has been said above about the steel scrap consumed by steel plants is likewise applicable to the iron scrap consumed by iron foundries.

The matter of scrap purchasing prices looks totally different.

Scrap, as a recovered raw material for the metallurgy of iron, is of tremendous importance to national economy. Such scrap is used as charge material for blast furnaces and in steel plants, iron foundries, and so forth. The extent of the demand for scrap will amount to millions of tons during the forthcoming five-year plan.

To supply this demand it is necessary to:

(a) intensify the collection of scrap, especially of the scrap types most easily perishable, such as light steel scrap;

(b) organize the thriftiest possible consumption of scrap in the metallurgical and casting industry.

A properly and faultlessly elaborated scrap pricing system is of extreme importance to the fulfillment of these goals. This

system should create the conditions for a proper solution of the problems entailed in both the purchases and sales of scrap.

When purchased, scrap is a commodity even though only the enterprises of the socialist sector may be the purchasers. The action of the law of value although it is limited here in view of the type of purchaser, reveals itself with sufficient force and hence it has to be seriously considered when fixing the prices for purchasing scrap from the public, social organizations, and cooperatives. Among others, this is expressed in the ratio of purchasing prices of heavy steel scrap to prices of light scrap. Although heavy scrap has a higher metallurgical value, the price paid therefor to the collectors is twice as low as the price paid for light scrap. This is because the collection of light scrap requires a much greater outlay of labor and moreover the costs of transporting it to warehouses are higher. For instance a ton of heavy scrap gathered by collector in a field or from ruins or dumping grounds may consist of several or a score of pieces of steel girder, pipe sections, chains, or artillery shells. Such scrap occupies relatively little space and thus the collector is enabled to utilize efficiently his means of transport. On the other hand, the collection of a ton of old tincans, sheet-metal trimmings, narrow pipes, or fittings less than 3 mm thick is much more arduous and the cost of transporting such a ton is much higher because no more than several hundred kg of such scrap can be loaded onto the platform of, e.g., an automobile. Therefore the collector, be he private or a state organization, is paid at the rate of 103 zlotys per ton for heavy scrap and 250 zlotys for light scrap, upon delivery to warehouse.

The economic expediency of such a pricing system consists in that it acts as an incentive to scrap collectors and thereby safeguards the domestic scrap resources from being destroyed by corrosion, covered by snow, buried in the ground, etc.

It would be also worthwhile to mention that in the course of the past decade the scrap purchasing prices have changed (increased) in proportion with the decline in the resources of postwar scrap and the increase in the distance between its location and the railroad stations and warehouses.

Then even several years ago (first introduced in 1949) the prices paid to private and socialized scrap collectors differed depending on the region of Poland. These prices were higher in the scrap-poor regions such as the Lublin Wojewodztwo and lower in the regions with extensive resources of postwar scrap such as Lower Silesia. However at a later stage, when the differences in regional scrap resources diminished, regional price differentiation was abolished and the newly introduced nationwide official scrap purchasing prices were based on the price level prevailing in the regions having the least scrap resources.

Generally speaking it is to be stated that the scrap purchasing prices were determined in such a way as to make scrap collection profitable without however involving any unnecessary expenditures of government funds.

Another instance of the utilization of the law of value to intensify scrap collection is the introduction of an additional incentive in 1955 for the social organizations conducting scrap collection. Block committees, parental committees in schools, volunteer

fire departments, youth organizations, and other groups establishing scrap collection and purchasing stations are paid for their collected steel and iron scrap at a price that is 147 zlotys/ton higher than the price paid to private collector, and furthermore they receive a surcharge of 90 zlotys a ton for transporting scrap to warehouses. In this way the heavy steel scrap delivered by a social organization to a scrap warehouse is paid for at the price of:

103 zlotys/ton + 147 zlotys/ton	= 250 zlotys/ton
Transport surcharge	= 90 zlotys/ton
Total	340 zlotys/ton

Whereas private collectors are paid 103 zlotys a ton for heavy scrap and for delivering light scrap the social organization receives:

250 zlotys/ton + 147 zlotys/ton	= 397 zlotys/ton
Transport surcharge	= 90 zlotys/ton
Total	487 zlotys/ton

Whereas private collectors are paid 250 zlotys per ton.

If a certain social organization merely collects scrap without delivering it, and the scrap warehouse has to use its own or hired means of transportation to get the scrap, the price paid by the warehouse to the organization amounts to 250 zlotys a ton for steel scrap, i.e., the price of heavy scrap (even if such scrap has been separated on the spot into light and heavy scrap). This principle is applied not only because heavy and light scrap may intermix during their transportation and thus cause additional costs to the warehouse owing to the necessity of reseparating them, a much more important reason was behind the creation of additional incentives for prompting the social organizations to deliver

themselves the scrap they collected. This is because a scrap warehouse has limited transport possibilities and thus, if this pricing system were not applied, the scrap collected would have to wait months before being delivered to the warehouse.

Such a scrap purchasing price system creates further incentives for the employees of scrap warehouses. They become interested in scrap transporting because the light steel scrap collected by social organizations is purchased from the warehouse by the interested party (a steel plant or a storage center of the Central Board of Scrap Management) at the price of 497 zlotys a ton plus 90 zlotys as compensation for transport, or altogether 587 zlotys per ton. Hence this 587 zlotys a ton includes (when scrap is delivered to the warehouse):

397 zlotys/t -- payment to social organization, for scrap
90 zlotys/t -- reimbursement of transport costs to social organization
100 zlotys/t -- warehouse profit margin to cover its storing costs and the costs of transporting scrap to railroad station and transloading it onto freightcars

Total 587 zlotys/t

or (if the warehouse used its own means of transportation to convey scrap from collection stations):

250 zlotys/t -- payment to social organization for scrap
90 zlotys/t -- transport surcharge collected by warehouse
100 zlotys/t -- warehouse profit margin
147 zlotys/t -- additional warehouse profit (partly assigned to cover the increased costs of transporting light scrap

Total 587 zlotys/t

In this way both parties have been imbued with interest in the transporting of scrap.

The new scrap purchasing prices paid to social organizations may result in a gradual domination of all scrap collection by these organizations and thus a partial elimination of private collectors. This will however take place solely thanks to the creation of economic incentives and not through any administrative decree because the prices paid to private collectors have not been reduced and neither have their rights been restricted in any way. In this way the problem of socializing scrap collection will be solved without hampering the materialization of important goals on the sector of scrap deliveries.

The price list provides for the right of social organizations to purchase scrap from private collectors for the purpose of resale to scrap warehouses. However the maximum price payable to private purveyors by social organizations is fixed in the price list at a somewhat lower level than the price payable to them by warehouses.

The turnover in scrap is limited considering that cooperative warehouses are forbidden to sell it to any party other than those named by the Central Board of Scrap Management, such as scrap-processing plants, steel plants, iron casting plants, and scrap storage plants.

The purchasing price payable to warehouses has been fixed as "loco freightcar, loading terminal" and the sales price to the purchasing parties, at "franco freightcar, receiving terminal." These prices were so fixed as to prevent any additional costs to cooperative warehouses when, because they exert no influence on the

selection of the purchaser (who is designated by the Central Board of Scrap Management), they may have to send scrap over great distances. Otherwise cooperative plants would be totally discouraged from maintaining scrap warehouses, unless the warehouse profit margin is fixed at a level insuring the coverage of increased transport costs. However this last eventuality is unacceptable because it would cause unnecessary expenditure of funds by the state. Thanks to the establishment of the principle of "purchasing price -- loco freightcar, loading station," all these difficulties and unnecessary expenditures are averted.

However when fixing the scrap sales prices, the related problems are quite different. In this case what matters is that the purchasing party, such as a steel plant or an iron casting plant, should not sustain additional expenses because a certain scrap purveyor is located farther than other purveyors, especially because the purchasing party does not likewise exert any great influence on the selection of the purveyor.

If economic considerations should make it desirable to utilize the local raw material resources and to avoid unnecessary transporting (such a problem exists in respect to, e.g., gravels), it would be likewise expedient to establish the principle "loco freightcar, loading station" in relation to sales price. If, on the other hand, it is expedient to make the industry consuming a given raw material (such as scrap) independent of the purveyor's site, then the principle to be introduced in relation to sales price is "franco freightcar, receiving station."

The storage plants of the Central Board of Scrap Management organize not only the transit but also the processing of steel and

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iron scrap. This processing consists in the cutting of heavy scrap into furnace-charge dimensions, crushing of iron scrap into small pieces, packing of light scrap, separation of utile wastes, etc. Scrap that needs processing is sent to the Central Board of Scrap Management by the warehouses lacking adequate facilities for this purpose. A warehouse receives a higher price for its processed scrap which can be directly forwarded to a steel plant or casting plant, whereas the purchasing price paid to it for unprocessed scrap is lower as this has first to be processed by the storage plants of the Central Board of Scrap Management.

The difference between the purchasing price of scrap sent by a warehouse to a storage plant and the purchasing price of the scrap processed by the storage plant and shipped to a steel or casting plant is used by the storage plant to cover its processing, transport, and administrative expenses.

The last factor to be considered in the discussion of the problem of steel and iron scrap prices is the principle of applying the purchasing prices paid for such scrap to industrial plants and other units of socialized economy. Also the prices of alloy-steel scrap should be mentioned.

Industrial plants and other units of socialized economy -- whether they are or are not comprised in the plan for scrap deliveries -- are paid for their steel and iron scrap at the same rate as the private collectors delivering scrap to warehouses. This principle was established upon considering, among others, the fact that certain socialized plants (even those comprised in the plan of deliveries) must for various reasons (chiefly whenever the distance to the nearest railroad station is greater than the distance

to the nearest scrap warehouse) transmit their scrap to a scrap warehouse, upon the approval of the appropriate storage plant of the Central Board of Scrap Management. Moreover cooperative warehouses receive scrap from socialized institutions which collect it in small quantities. Thus these institutions participate in a way in the turnover of scrap collected from the public, and therefore in accordance with the law of value, they must receive the same prices as those paid to private purveyors.

The fixing of higher prices for enterprises, e.g., prices at the same level as those paid to social organizations, would not appear pertinent because enterprises possess considerable liquid assets, and often can deliver only relatively small quantities of scrap. Therefore the prices paid to them for scrap will not be sufficiently attractive even if they are increased considerably, and will not effect an intensified scrap collection. A more effective way of "activizing" plants and institutions in this respect is the paying of bonuses to the employees charged with scrap collection and delivery. Such bonuses are applied especially in the plants which ship directly their scrap to steel plants, casting plants and scrap-processing plants, upon being so instructed by the nearest storage plant of the Central Board of Scrap Management.

Likewise in the event of a direct delivery of steel scrap or iron scrap to a steel plant or iron casting plant, the delivering plant is paid at the same rate as that paid to private collectors delivering scrap to warehouses. However the costs of railroad transport are not in this case charged to the purveyor, i.e., the labor plant, because the price is computed as "loco freightcar, shipping station."

The prices of steel-alloy scrap differ from the prices of nonalloy steel scrap chiefly in that they take into account the value of alloy components (according to standard rates and the percentile content of each component). Besides these prices are applicable within a small circle of purveyors, that is, mostly to industrial plants consuming alloy steels and capable of properly classifying their scrap.

3. Prices of Refractory Materials

General characteristics of refractory materials. Direct relationship. Index of direct relationship. Cost of average weight scrap or cost in standard plant. Considering quality of products when determining prices. Prices of defective materials. Prices of imported raw and other materials.

The principal topic of this section is the problem of the direct relationship between prices. This is illustrated by the example of refractory materials. This section utilizes instances taken from the refractory materials industry to demonstrate that the best method is to base prices on unit costs of a standard plant and not on mean weighted costs for a given industry as a whole.

Refractory materials are used chiefly in metallurgy. Nonetheless they also fulfill a major role in other branches such as the glass, chemical, ceramics, and other industries. Refractory materials are used to protect certain installations from the negative effects of the thermal processes occurring in them. In this connection these materials should display resistance to the action of high temperatures; the resistance is insured by their high fusing point (on the average refractory materials have a fusing point

ranging from No 26 Ss, i.e., from 1,580°C, to No 32 Ss, or 1,710°C for the highly refractory ones and over 2,000°C for the especially refractory ones), and resistance to the chemical action of gases, slags, etc. Moreover refractory products should not change in shape and volume owing to a high temperature. Otherwise they would crack at sudden changes in temperature.

In view of their properties refractory materials are considered in Poland as scarce materials. Their quantity is relatively small and the costs of their production are unusually high. Some of them are manufactured from imported raw materials. It is clear therefore that they must be applied with the greatest thrift. Such materials include the chemically neutral ones that do not react to acidic and basic slags, such as chromite (fusing point -- about 2,050°C), zircon (2,000-2,650°C), sillimanite, carborundum products, and carbon blocks.

The most popular and relatively most available refractory materials are the chemically acidic silicaceous and aluminum-silicate products. The latter include quartz-chamotte and chamotte products.

Considering that the more valuable and also more scarce refractory materials may be nearly in all cases replaced (owing to technological considerations) with materials of slightly lower quality but less scarce in the Polish economy, a complete system has been set up for insuring the most thrifty and rational consumption of refractory materials.

However this is not the place for discussing details of this system. All the same it should be mentioned that a major part of

this system is the pricing arrangement for various kinds and grades of refractory materials. This arrangement is so designed that the prices of the most scarce materials are correspondingly higher. This is also justified by the fact that the extracting costs of the easily available refractory materials are in principle lower than the extracting costs of the more scarce ones. Therefore their price has been made dependent on the level of prime costs. Such a relating of price to prime costs may be termed direct relationship and expressed by means of the following formula:

$$\frac{P}{K} = Sp$$

where:

P = price

K = prime costs

Sp = index of direct relationship (expressing ratio of price of given product to its prime costs).

The price of a given product as resulting from such relationship amounts to:

$$P = K \times Sp$$

The direct relationship index for refractory raw materials of domestic origin amounts to 1.05 (prices for 1956). This signifies that, in addition to covering its prime costs, the sales price of a given product also insures a 5% profit. However this index has not been applied to all the prices of supply-investment goods determined according to the principle of direct relationship. Very often the direct relationship index has been assumed at 1.0 and in some cases even at a lower number. Of course this happened whenever circumstances made the obtainment of profits impossible or resulted in the expectation of losses.

A calculation of the height of prime costs, which is to be the basis for fixing the price of a specific refractory material, is generally not difficult, because here the problem of average prime costs is, in principle, absent.

Various refractory clays, quartzite, quartzite slates, and other minerals deriving from diverse regions and diverse mines in a given region, display -- in addition to their common traits -- specific properties affecting decisively the quality of minerals and the feasibility of their extraction. Therefore the refractory materials' price list specifies individual minerals not only according to kind but also to mine of origin.

The problem is not exhausted by stating that the prime costs in a specific mine should be used as the prime costs on the basis of which the price of a given mineral is determinable. It is to be added that such costs should be of a planned nature and not of a resultant one because otherwise it might happen that the height of prime costs adopted for determining the price would be based on specific and unrecurrable circumstances arising for subjective reasons during some given reporting period.

Emphasis is deserved by the fact that if a mine extracts refractory raw materials of differing properties and differing classification the accounting of the extraction costs of each of such materials is conducted according to identical methods and indexes -- for the purpose of determining both the planned and the resultant prime costs. This axiom affects the method for determining the prices of diverse kinds of refractory materials extracted in a single mine. It leads to the conclusion that the prices take into account to some degree the utile value of appropriate grades of a raw

material extracted in a specific mine. This is of great economic importance because it creates incentives for the extraction of the refractory raw materials having a higher utile value.

All these principles have found application when determining the 1956 prices of refractory raw materials. It is to be only added that when the prices of the clays extracted in the Strzegon region were being determined the costs taken into account were not the costs of individual mines but the average costs of the enterprise as a whole. The same pertains to the Boleslawiec quartzites.

Direct relationship can not only be used to compute the prices of minerals in raw state, it can be also applied to roasted minerals and to refractory material products such as fittings (universal-use straight fittings and keys, straights and keys for special use, milled products, batches, and fireproof masses). In this case the expediency of the application of direct relationship ensues from the above mentioned thesis that the height of the prime costs of refractory materials reveals somewhat the degree of their scarcity in national economy.

In a majority of cases similar or even identical refractory products are manufactured by a number of enterprises subordinated to the Central Board of Refractory Materials Industry. Hence there arises the following problem: which prime costs should be adopted as the basis for determining the price of a given product -- the costs of average weight products in all enterprises as a whole or the prime costs in enterprises selected as standard?

This problem is of a universal character. It arises whenever the price of almost any means of production has to be determined,

and so far it has not yet been solved. Thus there is nothing surprising in that various solutions have been applied in practice. It appears that the optimal solution would be to determine the prices of means of production on the basis of the prime costs in the plants selected as standard plants.

Let us attempt to study this problem by reviewing an example taken from the refractory materials industry.

The postulates for determining the prices of refractory materials in 1956 were based on the principle of average-weighted material cost, which appears wrong. This is because the differences in the technological facilities of plants and also the varying share of each plant in the output of given products might be inadequately expressed in the form of average-weighted material costs, as then the scale of difficulties in the execution of individual products might not be revealed clearly enough. This may be illustrated by the following example.

Three plants manufacture various kinds of fittings from refractory materials (in the table below these fittings are designated by letters , B, and C) out of identical raw materials and according to identical inspection norms per ton of fittings. However the differences in the quality of technological facilities of each of these plants, and other objective factors, cause the prime costs per ton of given type of fittings to differ in each of the plants. Let us now consider that, in view of the varying degree of difficulty in the execution of fittings in each plant the unit costs (per ton) of fittings A, B, and C, may be expressed by the ratio of 1:1.5:2. At varying shares of these plants (as envisaged in the yearly plan) in the production of fittings A, B, and C the average-weighted unit

prime costs would be expressed by a ratio different from 1:1.5:2, as it can be seen from Table 2.

TABLE 2

Product	Plant I		Plant II		Plant III		Total	
	Planned Output, in Thousands of Tons	Planned Prime Costs, in Zlotys Per Ton	Planned Output, in Thousands of Tons	Planned Prime Costs, in Zlotys Per Ton	Planned Output, in Thousands of Tons	Planned Prime Costs, in Zlotys Per Ton	Planned Output, in Thousands of Tons	Planned Prime Costs, in Zlotys Per Ton
A	5.0	100	3.0	80	2.0	120	10.0	98
B	3.0	150	2.0	120	4.0	180	9.0	157
C	2.0	200	10.0	160	1.0	240	13.0	172
Total	10.0	--	15.0	--	7.0	--	32.0	--

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If the prices of commodities are determined on the basis of their prime costs this problem may be solved by means of the following 3 methods.

(1) Prices are fixed upon taking into account the unit costs of the plant with the highest productive capacity.

(2) One of the plants is selected as standard plant. In such a plant the unit costs should be at a level that is most approximate to the average level of costs (on the scale of the branch of industry as a whole), whereupon such unit costs are used as the basis whereon to determine prices.

(3) Prices of individual products are determined upon taking into account the average-weighted unit costs for a given branch of industry as a whole.

The results of the adoption of any of the above solutions are illustrated in Table 3 (to simplify this example we assumed the direct relationship index Sp to equal 1.0).

TABLE 3

Product	Method I				Method II				Method III			
	Price Equals Unit Cost in Plant With Highest Productive Capacity	Profit (+) or Loss (-) in Zlotys Per Ton of Output of Given Product			Price Equals Prime Cost of Plant With Average Cost	Profit (+) or Loss (-) in Zlotys Per Ton of Output of Given Product			Price Equals Average Weighted Unit Prime Cost	Profit (+) or Loss (-) in Zlotys Per Ton of Output of Given Product		
		Plant I	Plant II	Plant III		Plant I	Plant II	Plant III		Plant I	Plant II	Plant III
A	80	-20	--	-40	100	--	+20	-20	98	- 2	+18	-22
B	120	-30	--	-60	150	--	+30	-30	157	+ 7	+37	-23
C	160	-40	--	-80	200	--	+40	-40	172	-28	+12	-68

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Let us first study the results of the adoption of Method III.

The results achieved by the individual plants will not show any regularity even though such regularity may occur with regard to prime costs. Although the prices may cover the mean weighted costs of the branch of industry as a whole, they do not reflect the prime costs of any specific plant. This causes a great divergence among the indexes of profitability of the manufacture of individual products in diverse plants, and moreover such indexes are not the effect of any definite economic policy but are rather the result of the actual distribution of production goals among the plants at the time when the average-weighted prime costs are being determined. As a result improperly acting economic incentives are promoted which cannot but exert an influence on the implementation and, especially, upset the plan for the range and variety of production.

From Table 3 it may be seen that the manufacture of Product C causes the greatest losses or the smallest profits to all plants. Hence it is nothing surprising in that the plants will, insofar as possible, shirk the manufacture of Product C or desist from overfulfilling the plan with respect to that product. On the other hand, they will be very interested in manufacturing chiefly Product B -- excepting perhaps Plant III where the losses on Product A are similar (and even slightly lower) than the losses of Product B. If it be assumed that Products A, B, and C denote various types of fittings, it becomes clear that the supply of some types will not suffice to cover the demand, while of other types there will be an oversupply. This is a very serious problem, because if the refractory materials industry fails to fulfill completely its plan of range and variety of output this may result in a delayed activation of many industrial objects.

True enough this may be obviated through administrative measures but these are not always effective enough, especially when economic incentives act in a contrary trend.

If Method I be adopted for determining the costs to serve as the basis for price fixing the results would be more favorable. In this case prices will cover the unit costs of production of all the range of products (manufactured by the plant with the highest productive capacity). Thus, if necessary, that plant may increase its output of the product that may prove more needed in national economy without thereby incurring losses. In the other plants the price level would not either be then a factor retarding the fulfillment of the plan of range and variety of output, even in cases when it is below prime costs (as seen in the above cited example) because the extent of loss per unit of cost will remain a constant value in individual products. Of course this takes place only whenever -- as in the above cited example -- the unit costs of individual products are identical or similar in the plants concerned. Appearances to the contrary however are not rare. But even when the ratios of unit costs of various products are expressed in differing figures in various plants, the use of the costs of the plant with the greatest productivity capacity as the basis whereon to determine prices safeguards, as noted before, the fulfillment of the plan of range and variety of output on the scale of industry as a whole.

What are the negative aspects of this solution (Method I)?

If the plant with the highest productive capacity manufactures more cheaply than its sister plants, the basing of prices on the prime costs of that plant would cause losses to the sister plants and thus the entire given industry would become unprofitable,

which is withal an undesirable phenomenon. A still worse situation would arise if on the contrary the costs in the plant with the highest productive capacity were higher than in the other plants (as happens in some branches of industry). Thereupon the entire branch of industry would indicate high accumulation which actually would be equivalent to the pump-priming of the funds from other state enterprises or of the funds assigned for coverage of investment projects (as in the case of the refractory materials industry).

For the above reasons the best solution would seem to be the adoption of Method II: the basing of prices on the unit costs of a plant selected as standard, i.e., a plant in which the costs stand at a level that is average for the given industry as a whole. Of course the plant selected should be the largest or one of the largest plants. Such a solution, by combining the advantages of Methods I and III, would at the same time eliminate considerably the negative aspects of these methods. By applying Method II industry is assured of having its production costs essentially covered, and at the same time the distribution of production targets does not exert any influence on the relationship among the prices of diverse products.

However the determination of prices of refractory materials in 1956 was based on the worst of these 3 solutions -- the average-weighted unit costs. The desire to liquidate losses in the refractory materials industry owing to a too low price level had prevailed over other considerations. Thus the problem of the proper interrelation of prices has not been worked out completely.

Nonetheless the issuance of a new price list for refractory materials constitutes a major stride forward. This is expressed

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chiefly in the circumstance that, first, prices were differentiated according to quality of products and, second, a principle was introduced to the effect that defective products (products not satisfying the qualitative requirements adopted in the official state standards) may be sold also but at a price 30% less than the price of good-quality products.

The prices of secondary-quality products are 15% lower than the prices of the corresponding primary-quality products (here the terminology used is from the price list of refractory materials where the term "grade" is interpreted in a somewhat different way than in other price lists). This is very disadvantageous to plants whose output includes a large percentage of secondary quality products, especially considering that the prices determined on the basis of direct relationship according to the formula P = K x Sp pertain to primary quality products.

It is to be emphasized that this principle has found a widespread application also in a number of other price lists which provide either for the so-called percentile discounts on sales prices in the event that the proper quality of a product is not maintained or for a differentiation of sales prices depending on the quality of products.

The principle that defective products may be marketed but at a price 30% below the price of regular products is of 2-fold importance to national economy. On the one hand, it is a strike against inefficiency, through stimulating reforms in enterprises whose output includes a major percentage of defective products, and on the other hand it facilitates the marketing of defective products by enterprises posing smaller requirements regarding the

quality of the applied refractory materials. In the past defective products were regarded as scrap to be used in the manufacture of chamotte products. According to the new price list the prices of refractory fittings deriving from the dismantling of old furnace fireboxes, etc, are also 30% lower than the prices of articles of good quality deriving from regular production. These fittings must, of course, satisfy specific qualitative requirements; otherwise they are regarded as scrap and priced correspondingly much lower.

A discussion of the prices of refractory materials cannot overlook the problem of determining the prices of imported refractory materials. The rapid development of Polish industry, especially of heavy industry, necessitates the importation of a certain quantity of refractory materials from abroad in spite of the tremendous growth in their domestic output and in their quality.

The best solution would be to base the prices of imported raw materials and products (prices paid by a domestic customer to the appropriate foreign trade bureau) on the principle of equivalent relationship, insofar as possible. If this principle be adopted the domestic price of an imported refractory material will be essentially the same as the price of an identical domestically manufactured material. If however a given raw material or finished product is not manufactured domestically, the domestic price of the imported commodity is determined upon applying equivalent relationship to the price of a domestically manufactured commodity that is of the most similar nature, upon taking into account the equivalency index (ratio between the utile values of both commodities). This principle applies not only to refractory materials but also to other imported means of production.

If the determination of the prices of imported refractory raw materials is not based on the principle of equivalent relationship, there may occur a distortion of the relationship among the prices of products which are partly manufactured from domestic materials and partly from imported ones. A similar situation would occur with respect to finished refractory products imported from abroad. The ignoring of the utile value of imported products in relation to domestic products, when determining their prices, would cause the purchasers to acquire chiefly imported products (if their prices are fixed at a low level), or it would cause an involuntary rise in the expenditures of the enterprises supplied with imported products (if their prices are fixed at a high level).

It appears that the domestic prices of all imported refractory materials may be essentially determined on the basis of equivalent relationship. This is because, in principle, all refractory materials serve the same purpose: protection of diverse facilities, equipment, and plant assemblies from the destructive action of high temperatures.

Cases when equivalent relationship is not applicable to the fixing of the prices of imported commodities -- and when therefore it is necessary to adopt other solutions -- will be discussed in the chapter on nonferrous metals.

4. Prices of Other Major Commodities

Coke. Coal. Gas. Prices versus scheduled rates.

Among the problems touched upon in this section the paramount one is how to conduct accounting of deliveries when the prices

of some minerals are so differentiated that a proper classification of a given delivery according to the price list requires prior laboratory analysis, which in practice is not feasible owing to various reasons. The lack of a solution of this problem hampers (e.g., in the case of fluxing agents) the consideration of the factor of quality in the prices of certain minerals. It appears that a method of accounting for coal deliveries may also find application in many other cases and may considerably lessen the above cited difficulties.

This section also contains an attempt at an explanation of the difference between the concept of price and the concept of scheduled rate.

One of the principal raw materials of ferrometallurgy is blast furnace coke which fulfills a 2-fold role in the pig iron production process.

(1) It furnishes the heat necessary for liquifying the blast furnace charge and reducing the iron oxides contained in the ore.

(2) It makes possible the obtainment of metallic iron, because during the reduction process the carbon (C) contained in the coke combines with the oxygen of the ferro compounds contained in the ore.

Blast furnace coke should contain the highest possible percentage of pure carbon (C), and the least possible percentage of other components, especially of ash which affects very adversely the results of blast furnace operation. According to various empirical data every 1.0% increase in the ash content of coke (above

the 9.0% limit) causes a 1.5-2.0% increase in the outlay of coke per ton of pig iron and a proportional decline in the daily productivity of the blast furnace.

The extent of coke consumption and blast furnace capacity are most adversely affected by the degree to which the sulfur contained in coke penetrates the pig iron. The chemical combining of this sulfur and uniting with slag requires additional dosages of fluxing agents and coke, and this also lowers blast furnace productivity. The indexes of increase in outlay of coke in kilograms per ton of pig iron at a 0.1% increase in the sulfur content of coke are as follows -- according to diverse authors. (See Terminarz Technika na rok 1955 [Technician's Manual for 1955], issued by the Main Technical Organization, 1954, page 180 -- data compiled by N. Krasawcew.)

(a) According to L. Ulicki:

17 kg at a coke with a sulfur content of 1.67-2.17%

10 kg at a coke with a sulfur content of 1.17-1.67%

7 kg at a coke with a sulfur content of 0.67-1.17%

(b) According to . Gotlib:

15-20 kg at a coke with a sulfur content of over 1.5%

5- 8 kg at a coke with a sulfur content of below 1.5%

As can be concluded from the above, the sulfur content of coke exerts a tremendous influence on the results of blast furnace performance.

The quality of coke is also adversely affected by its water content. True enough hydrogen (whether previously combined with carbon, or with oxygen -- when it creates H_2O) also participates

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actively in the reduction of iron oxides but, on the other hand, this involves a tremendous consumption of heat (and therefore coke) necessary for the prior decomposition of water contained in coke into free hydrogen and oxygen. Therefore blast furnace coke should not only have the smallest possible content of sulfur and ash but also have the smallest possible content of water.

The quality of blast furnace coke is affected, besides its chemical composition, by its mechanical properties. Blast furnace coke should not be crushed inside the furnace by the enormous burden of charge materials (weighing several hundred tons in the lower parts of the furnace) as it would then hamper a free flow of reducing gases, and hence it should display appropriate strength which is defined by 2 indexes: hardness and abrading quality. In view of the flow of gases in the furnace the degree of granulation of coke is also of some importance to the blast furnace process.

How well have these factors, decisive to the quality of coke, been considered during the determination of new prices for 1956?

These factors have been considered only partially. Blast furnace coke has been divided into 3 grades depending on its mechanical properties and 4 groups depending on its degree of granulation. On the other hand the sulfur, ash, and water contents have not been taken into account. In this way the relationship among the prices of various grades of blast furnace coke does not fully take into account the utile value of individual grades. Under the present conditions this cannot influence considerably the purchaser's attitude, as he is compelled to receive whatever coke may be delivered to him by his purveyor (because coke is a scarce material).

Nonetheless the lopsided interrelationship of the prices of blast furnace coke affects adversely the purchaser's economic accounting. Inasmuch as prices do not reflect the quality of blast furnace coke the purchasing foundry may involuntarily incur either an increase in its prime costs or a seeming decrease therein. The latter phenomenon will occur more rarely because such an interrelationship of prices is not a factor mobilizing coke-plant personnel in the struggle for raising the quality of production. True enough the sulfur and ash contents of coke hinge preponderantly on the quality of the coking coal delivered by the coal industry to the coking plant, but the coking plant itself may exert a decisive influence on the water content of coke.

The principle that the purchaser is entitled to reject a coke delivery if the water content exceeds the standard limit is not an adequate measure at all. First the purchaser is partly in a position of pressing need which compels him to accept coke regardless of its quality, and second, coking plants have no interest at all in reducing the water content of coke below the permissible standard limit, although this would improve considerably blast furnace performance. At the present situation, in order to facilitate the fulfillment of their production plans, coking plants are not going to spare any water when quenching their coke (especially at wet quenching).

It seems that a future revision of the pricing system should consider the problem of the quality of blast furnace coke as fully expressed in the interrelationship of the prices of diverse grades of such coke. Here use may be made of the composite relationship method which will be described later on in a discussion of pig iron

prices. Also it would be advisable to use the prime costs of a standard plant as the basis for determining the price level instead of the mean weighted prime costs used as such basis in 1956. This is because the considerations applicable to the prices of refractory materials are equally valid in relation to blast furnace coke.

A discussion of blast furnace coke necessarily entails a mention of its original raw material, namely coal.

As is known coke is obtained through gaseous distillation of black coal. However not every grade of coal is equally suitable for processing into coke. In view of the difficulties in supplying coking plants with sufficient quantities of high-grade coking coal, use is made of mixtures of various grades of coal. The best grades of coking coal are used to enrich such mixtures. In this connection such enriching best grades should be used as thriftily as possible, and hence their prices must be so determined as to constitute a major factor in their thrifty consumption. The 1956 price list expressed this principle by fixing the prices of the enriching grades of black coal at a much higher level than the prices of the coal consumed for power generation purposes.

In Poland the cost of extracting the enriching grades of black coal is generally higher than the analogous costs for other grades of coal. Nonetheless the application of the principle of direct relationship to coal prices would not be justifiable. This is because geological conditions cause the extracting costs of individual grades of coal to be of a quite accidental nature. The struggle for coal savings should hence be concentrated on the sector of reducing the consumption of the grades of coal that are most valuable and also most scarce and not of those grades whose extracting

costs stand at the lowest levels under specific conditions. But even if the extracting costs of the enriching grades of coal were to be lower than the analogous costs of power-generating grades of coal, the prices of the former should be higher than those of the latter.

As can be concluded from the above, so far as coal is concerned the most applicable principle would be that of equivalent relationship, as discussed in the section on scrap.

Through a proper aligning of the equivalent relationship indexes (S_e) it is possible to express certain definite trends arising in national economy. For instance in order to increase the incentives for a greater consumption of slack and low-grade coals, their prices should be fixed at a lower level than they should be considering their caloricity as compared with other grades of coal. On the other hand the equivalency indexes (Qs) should not express any trends of economic policies but should rather express the objective factors affecting the utile value of coal, such as caloricity, chemical composition, ash content, content of volatile constituents, and so forth.

One might risk propounding a thesis that the correctness of the relationship among the prices of diverse grades of coal hinges decisively upon whether the equivalency indexes have fully taken into account the most vital parameters reflecting their utile value, and that this also depends on the pertinence of the assumptions by which we were guided when determining the indexes of equivalent relationship.

The economic significance of this problem is obvious even if only from the attempts undertaken by the coke-chemical industry to reduce its prime costs by using the cheaper grades of coal in the mixtures charged into coke-oven batteries. The most recent attempts to use coal of the power-generating type for this purpose have been crowned with complete success and have resulted in a major reduction of costs in that industry.

Aside from the determination of proper prices for diverse grades of coal, another very important problem is a proper pricing classification of the coal extracted from diverse strata in individual mines. It would be practically unfeasible to analyze, e.g., the chemical composition of every coal delivery, and therefore coal is classified according to its site of extraction. Such a practice, which, true enough, facilitates the accounting between purveyors and purchasers, causes the latter to protest against faulty deliveries, and often with good reason. An improper classification of collieries may limit considerably the efficacy of even the most rational postulates adopted for determining coal prices. In addition there occur changes in the classification of collieries, and such changes upset the financial planning of the purchasers who suddenly have to pay different and often higher prices for the same grade of coal. For these reasons it appears that any changes in classification should be carried out solely in exceptional cases and even then the purchasers' interests should be considered as greatly as possible.

It is also to be mentioned that the adoption of the principle of equivalent relationship does not conflict with the trend for fixing coal prices at a level that would insure the profitability of coal industry. However to achieve this it is necessary, after a

prior determination of the prices of individual coal grades, to estimate the value of the over-all output and, if it is found that value differs by a specific percentage from the over-all sum of the prime costs of marketed output, the prices should be commensurately revised.

Fluxes occupy a place of no small importance in the blast furnace process. They include limestone and dolomite. The purpose of fluxes is to create the proper balance $(SiO_2 + Al_2O_3):(CaO + MgO)$ in blast furnace slag, that is, to bring the basicity of the slag to the proper degree. Without fluxing agents the blast furnace process would result in the appearance of iron silicates in nearly all the ores charged (save the self-fluxing ores whose gangue contains a great quantity of bases), and these silicates are reducible only with great difficulty in the absence of calcium or magnesium oxides. Fluxing agents also fulfill another important role by decreasing -- through decomposing iron sulfide and creating calcium or magnesium sulfides which combine with the slag -- the sulfur content of pig iron.

The quality of fluxing agents depends on their chemical composition and degree of granulation. Silica and clay (contained, e.g., in limestone) act negatively because then additional dosages of limestone and coke are necessary for creating slag. Limestone slack having a granulation of less than 25 mm should not be used either. This does not mean though that the greater are the lumps of limestone or dolomite the more suitable they are. Large lumps of fluxing agents are undesirable because they disturb the regular performance of blast furnace and require a greater outlay of coke.

Therefore these factors should be taken into account when determining the prices of limestone and dolomite. However both these raw materials are also used in the production of binding materials -- in relatively greater quantities too. In the binding materials industry the lumpiness (granulation) of a charge is likewise of great importance but there the chemical composition of the above mentioned materials is of much less importance. The fact that the 1956 prices of limestone and dolomite were determined concurrently with the prices of binding materials has exerted some influence on the relationship among the prices of various grades of these materials. These prices were fixed chiefly from the viewpoint of the degree of granulation, and without taking properly into account the influence of the content of silica or clay on the quality of limestone or dolomite. The major factor considered in fixing these prices was the prime costs of extraction and the costs of granulation and sorting. Thus, for example, the price of small-lump limestone with pieces having a cross-section of 5 to 15 cm amounts to 30 zlotys a ton; for medium-lump limestone (12 to 25 cm) it amounts to 35 zlotys a ton; and for large-lump limestone (25 to 40 cm) it is 36 zlotys a ton. In this connection the price list does not mention any reservations regarding the chemical composition of the limestone. It is only in the case of rejectable limestone with lumps 0 to 5 cm thick that 2 different prices can be applied depending on the $CaCO_3$ content. The price of rejectable limestone containing over 90% $CaCO_3$ amounts to 90 zlotys a ton, and if it has less than 90% -- only 12 zlotys a ton. However it is to be emphasized that this sort of differentiation is quite primitive.

True enough the ferrometallurgical industry includes some of the quarries, but their output does not cover its demand. The

limestone supplied by outside quarries is often of inadequate quality, and the pricing system for such limestone does not create sufficient incentives for raising its quality. Although the solution of this problem is rendered difficult by objective reasons it would appear expedient to undertake steps in this direction in the future.

In this case the solution adopted for determining coal prices might be also applied here on an interim basis. However the prices of limestone should be more widely differentiated, the number of grades considered in the price list should be increased, and eventually various categories of limestone should be introduced. In this connection these grades and categories should pertain to limestones with specific chemical composition. Next individual quarries should be classified commensurately with the grades or categories of limestone they contain. Thanks to this it will no longer be necessary to submit every delivery to laboratory inspection and at the same time an interrelation between the height of the price and the quality of limestone will be insured at least to some degree.

In ferrometallurgy gas is consumed chiefly in open-hearth steel plants and in heating furnaces where raw steel in ingots or in the form of rolled products is heated to the temperature necessary for the rolling process. A considerable part of the gas they consume is received by the steel plants from their own coking-oven batteries, gas flues, and blast furnaces. Nonetheless considerable quantities of gas have also to be acquired from the outside by some plants. Therefore the prices of the consumed gas fulfill some role in processing costs.

Gas is sold to steel plants according to scheduled rates and not according to prices. Here we are dealing with a schedule of rates and not with a price list. It would be difficult to supply here a complete definition of the scheduled rate. However a brief definition of that rate would be pertinent.

Prices usually pertain to raw and other materials and finished products of all kinds, which can be stored and preserved for some time, that is, to means which can be stockpiled for the future and whose consumption in the production process may occur after the elapse of some time since the moment of their delivery.

Scheduled rates, on the other hand, pertain in principle to products (and services) consumed at the moment of their appearance, and hence to transportation services, and to various forms of power such as electricity, gas, water, steam, and the like.

The above problem is of great economic importance. Therefore the postulates adopted for determining scheduled rates often differ from those adopted for determining prices. This is expressed among others in the privileged treatment of certain purchasers and chiefly in the differentiation of scheduled rates depending on the purpose for which a purchaser consumes the power supplied to him. For instance one and the same kind of gas when sold for illuminating purposes is priced at a different rate than when sold for heating purposes and at a still another rate when sold as raw material for production (in chemical industry). Scheduled rates charged for power consumed above the assigned limit are higher than rates for power consumed within the limit. The schedules of rates for power supply provide moreover for charging lower rates or rewarding the purchasers who contribute to the most thrifty

utilization of power. This is expressed in the schedule of rates for gas supplies where the rates for excess coking gas are much lower. This is the gas which would otherwise be burned in the so-called "torches" on Sundays and holidays owing to the then reduced demand for gas, in order to prevent it from polluting the air if liberated. Incidentally it is to be mentioned that the schedule of rates for electric power contains similar provisions, e.g., reduced rates for subscribers consuming electricity at night outside of peak hours, rebates for high cos, etc.

The fundamental purpose of this rate policy is to arrange the scheduled rates and rate decisions so as to utilize most efficiently these forms of energy in national economy considering that they just cannot be stored.

The previously mentioned scheduled rates for gas pertain, of course, to rates charged to the purchasers who use it for processing, heating, or illuminating purposes. However it must be also explained that a gas producer has to deal with a different kind of contracting party, namely the gas industry, which receives gas, eventually purifies it (coking gas), and distributes it through a network of pipelines to various purchasers. Here the gas industry is a middleman between the gas producer and the gas purchaser (aside from the fact that this industry itself is also a gas producer).

Hence there arises the question what price (here we mean a price and not a scheduled rate because this term is customarily applied in relation to purchase from the producer) should be paid by the gas industry when acting as the middleman? In order to determine the purchasing price payable by the gas industry it is first necessary not only to determine the level of profitability of the

gas industry but also to solve the problem of the price of excess coking gas.

Beginning with 1 January 1956 excess gas is sold to units of socialized economy at a scheduled rate of 60 zlotys per 1,000 cu m. To insure the profitability of coke-chemical industry the purchasing price of coking gas payable by gas industry has been fixed at 210 zlotys per 1,000 cu m.

This entails yet another question. Is it right that the gas industry, as a distributor, should purchase gas at the price of 210 zlotys per 1,000 cu m and resell it at 60 zlotys per same volume just because the question whether gas is excess or not cannot be settled until after it is sold to gas industry by the producers?

Hitherto gas industry used to purchase excess gas from the producer at a higher price than that charged to the ultimate purchaser. This was because of the opinion that gas industry in its capacity as a distributor exerts some influence on the rational consumption of gas for heating purposes or in chemical industry (in the latter case gas was sold at normal scheduled rates). It was also believed that the coke-chemical industry should not sustain losses for this reason and that, for instance, gas industry as a distributor fulfills its duties inadequately and that, hence, a part of gas will not find purchasers at normal scheduled rates, unless it is sold as excess gas. However this reasoning ignored the circumstance that the coke-chemical industry may, like any other industry, have its output plans lowered, including also the plan for the yearly output of gas. On the basis of the plans of the coke-chemical industry, gas industry maps out the distribution

of gas and its profitability, upon considering that on Sundays and holidays a part of the gas will have to be sold at excess-gas rates. And yet in the course of the plans' fulfillment it has been found that gas industry is furnished with much greater quantities of gas than planned. The purchasers, having previously adjusted their production plans to the expected volume of gas deliveries, cannot alter these plans. As a result there have arisen unexpected losses, financial difficulties, and similar phenomena. Thus there is nothing surprising in the reluctance of gas industry to accept excess gas, so that coking plants are often compelled to burn it up in the so-called "torches." This is, of course, disadvantageous to national economy.

Therefore a different solution has been adopted for the year 1956. The producers henceforth are paid the regular coking-gas price for the gas they furnish in accordance with the plan, that is, the price of 210 zlotys per 1,000 cu m, and a reduced price of 60 zlotys per 1,000 cu m of any quantities of gas they furnish above and beyond the plan, i.e., the same price as that charged by gas industry for excess gas. Thus gas industry sustains no losses when acting as excess-gas middleman between producers and purchasers. However whenever gas industry charges a rate of 210 zlotys per 1,000 cu m of such plan-exceeding gas, it pays the producer at the same regular rate.

The above solution may perhaps not be a perfect one but it yields the following results.

(1) It creates incentives for a realistic planning of output in the coke-chemical industry and in the coking plants belonging to the ferrometallurgical industry.

(2) It contributes to reducing losses in gas industry thanks to the elimination of the difference between the purchasing price of plan-exceeding gas and its scheduled rate.

(3) It prompts gas industry to transmit gas principally to those purchasers who utilize it most rationally.

When speaking of gas, mention should be also made of marsh gas which is produced by the petroleum industry. This kind of gas is also distributed by the gas industry. The caloricity of marsh gas is twice as high as that of coking gas, and it is a valuable raw material for chemical industry. In order to curtail the consumption of marsh gas for heating purposes the scheduled rate for such gas is (when consumed for heating purposes) twice as high as that for coking gas.

Whenever it is not at once received by the gas industry, marsh gas is stored in the earth, which constitutes a natural marsh gas reservoir. Therefore marsh gas cannot be excess gas and, beginning with 1 January 1956, the gas industry will pay for it at the fixed purchase price of 400 zlotys per 1,000 cu m.

CHAPTER II. SALES PRICES OF FERROMETALLURGICAL PRODUCTS

1. Pig Iron

General characteristics of pig iron. Processable pig iron versus foundry pig iron. Changes in interplant cooperation and the prime costs of marketable output. Application of sales prices in interdepartmental turnover. Index of composite relationship. Prices versus profits. Prices of individual grades and types of pig iron. Prices of defective pig iron.

In the field of price policies one of the most interesting problems is how to apply sales prices in interdepartmental turnover within individual plants. This problem concerns not only ferrometallurgy but also many other branches of industry which involve, on the one hand, phase cycles of production and, on the other, frequent changes in deliveries of semifinished products among individual enterprises. The often discussed problem of the application of sales prices in interdepartmental turnover will be reviewed here from a novel viewpoint, on the basis of instances taken from ferrometallurgy. The conclusions that may be inferred from these instances can be also applied to other branches of industry.

This section will also describe -- with pig-iron prices as the example -- one of the more interesting types of price relationship, namely, composite relationship which may often be an effective means of influencing an improvement in the quality of products.

The concept of "pig iron" is construed as meaning a large group of the basic semifinished products manufactured through ferrometallurgy. The chemical composition of pig iron contains, aside from iron, carbon and manganese, also a considerable percentage of impurities, chiefly silicon, phosphorus, and sulfur. From the viewpoint of destination, pig iron is differentiated into processable types (open-hearth, Bessemer, Thomas) and casting types (regular, special, phosphoric, spiegel, etc). All kinds of pig iron are classifiable into types and grades depending on chemical composition. The steel plants subject processable pig iron to the sintering process, which consists in burning out the harmful admixtures and any excess carbon. There also pig irons are given a crystalline

structure proper for steel. Processable pig iron is suitable only for processing into steel.

From the economic point of view the organization of production in ferrometallurgy is most advantageous when processable pig iron can be used in liquid state with the steel-making department of the same foundry in which it was manufactured. This saves on the heat (reduces the consumption of gas) which would otherwise have to be expended on melting the "pigs" of iron. Therefore the planned development of heavy industry places special emphasis on the expansion of blast furnaces in steel plants.

According to the official financial system, processable pig iron in liquid state consumed in the steel-making department of the same plant is included in further production on the basis of prime costs. Therefore sales prices are applicable only to pig iron in solid state.

A question may arise whether the problem of a correct determination of the price level of processable pig iron is of great importance considering that its share in the marketable output of steel plants (with respect to the pig iron set aside for sale) should be gradually reduced.

The specific situation and conditions of performance in Polish steel plants necessitate a continued complete or partial supplying of certain plants with processable pig iron purchased outside. In addition, a correct determination of the prices of processable pig iron is an indispensable requirement for determining the correct prices of casting iron, which in some ways is a finished product of ferrometallurgy because it is consumed outside, as the

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charging material for cupola furnaces, e.g., in the machine-building industry. Therefore in practice a major part of the produced casting iron is included in marketable production.

The factor interrelating these 2 kinds of pig iron, which should be considered when determining prices, is that blast furnaces can produce both processable iron and casting iron. Therefore if the price of casting iron is compared, e.g., with its prime cost, while the price of processable iron is determined without considering its prime cost, there will occur a distortion in the system by which economic incentives influence the fulfillment of the plan of the range and variety of output. Individual steel plants may be interested in increasing or reducing their output of processable iron (depending on the relation of price to prime cost) at the expense or to the advantage of their output of casting iron; and this may conflict with the needs of national economy. This may happen, of course, only with respect to plants producing enough processable pig iron to supply their own steel-making departments and still to have some left for sale to the outside.

Hence, in view of these circumstances, it may be stated that a proper interrelating of pig iron prices requires the adoption of a single criterion for determining the price level. Such a criterion can be only the basing of prices on prime cost.

As noted before, at present in spite of the strivings to attain complete production cycles in individual plants processable pig iron and other semifinished metallurgical products still continue to be part of interplant turnover. In view of the considerable difference between the prices and the prime costs of pig iron it can

be seen that in a given steel plant the prime costs of steel, and in turn also of rolled products, depend among others on the ratio of the pig iron from the plant itself to the outside pig iron in the furnace charge. For instance if the price of outside pig iron is much lower than the costs of producing pig iron with resources of the plant itself, the plant will reduce more easily the prime costs of its steel and rolled products and hence the prime costs of its marketable output by purchasing more pig iron from outside. Under certain conditions this circumstance may retard the personnel's efforts to increase blast-furnace capacity, especially when the management of the steel plant receive bonuses for reducing prime costs.

The same pertains to the other semifinished metallurgical products sold in interplant turnover, such as cast steel in ingots, billets, blooms, etc.

With regard to pig iron deriving from another plant, the steel plant must also consider the additional costs connected with melting it to a liquid state, and it must calculate whether the cost of melting will cover the difference between the price of cast iron and its prime cost. However this consideration does not apply to other products; the difference between their purchasing price and prime cost causes directly either a reduction of the prime costs of marketable output in the plant consuming these semifinished products (in the event that their share in the over-all mass of processed materials increases), or an increase in the prime costs in cases to the contrary.

Phenomena of this kind have arisen during the domination of the sales prices of metallurgical products before 1956.

Chiefly for these reasons proposals were advanced for the partial modification of the pricing system in the ferrometallurgical industry (and in others, such as textile industry), as consisting in the introduction of the principle that semifinished products subject to interplant cooperation should be included in the further production of the plants in which they were manufactured according to official sales prices and not to prime costs. That is, they should be appraised on the same basis as imported semifinished products. In this event the prime costs of finished ferrometallurgical products and hence also the prime costs of marketable output would not be liable to fluctuations owing to changes in interplant cooperation, i.e., owing to changes in the percentage of semifinished products purchased outside in the total mass processed. This would yield a direct and simple method for eliminating the influence which any eventual difference between the costs of producing a given semifinished product and the costs of purchasing it from the outside might exert on the reduction of prime costs of an enterprise as indicated in its periodic reports. If the price of a charging material be uniform regardless of the size of its production, this will facilitate the economic analyzing of not only an enterprise as a whole but also of its individual production departments.

The application of sales prices in interdepartmental turnover has, though many negative aspects, its specific advantages. Therefore some authors propose that this system be introduced in ferrometallurgy only for an interim period (see S. Herszenberg and J. Borysiewicz, "A Uniform Pricing System for Semifinished Products in Interdepartmental Turnover," Gospodarka planowa [Planned Economy], No 7/8, 1953; and Zbigniew Augustowski, Planowanie kosztow wlasnych

w przemysle /Planning of Prime Costs in Industry/, Polskie Wydawnictwa Gospodarcze Publishing House, 1954, page 80), until such time when sales prices will be fixed on the same level as prime costs, although in certain industries (textile, papermaking, meat) this system has been introduced on a permanent basis as a major factor of economic accounting.

The negative side of this system is that it distorts the prime costs of the products belonging to the marketable output of individual enterprises and, therefore, it also distorts the prime costs of that output on the scale of a branch of industry as a whole.

To illustrate this thesis let us cite the following example.

Let us assume that Foundry X, in which the prime costs of pig iron are much higher than in other foundries, and hence higher than the sales price, has increased its output of pig iron by 30%, thereby making possible a 15% increase in the steel production of that foundry or a 3% increase for the metallurgical industry as a whole. If the processing costs per ton of steel and the yield per metallic charge in the steel-making department of Foundry X stand at a level average for the metallurgical industry as a whole, then at such a system periodic statistical reports will indicate that the prime costs of total steel output have also increased 3%. However this is not correct. The quantity of means consumed to manufacture that additional 3% of steel will -- according to the above cited example -- actually exceed 3%. To appraise properly the magnitude of the consumed means, it is necessary to increase the prime costs by the difference between the sales price and the prime cost of the consumed pig iron.

This is because if sales prices are applied in interdepartmental turnover the prime cost of marketable output will not fluctuate (rise) if a rise in costs occurs during the preliminary production stages or too if there is an increase in the output of semifinished products in plants where prime costs stand at a relatively higher level. This difficulty is being somewhat surmounted through introducing the principle of computing the reduction in costs and analyzing the dynamism of costs in relation to over-all turnover (total output), which constitutes the sum of successive stages of production (this problem is touched upon by S. Herszenberg in his article "Concerning Uniform Prices," published in Finanse /Finance/, No 3, 1954).

However this solution does not eliminate the greatest of the errors arising in the application of sales prices to interdepartmental turnover, namely, the error consisting in the distortion of the statistically shown reduction in prime costs in the event of any changes in the quality of the semifinished products manufactured by the enterprise itself.

This may be illustrated with the following 2 examples.

(1) In Foundry X there occurred, owing to improved performance of its blast furnaces, an improvement in the quality of its pig iron, and the percentage of defective pig iron (containing harmful impurities to an extent above the permissible norms) was reduced by 1/2.

(2) In Foundry Y there occurred, owing to diverse omissions, an increase in the share of defective pig iron in the total output of its blast furnaces.

Here let us assume that in both foundries the prime costs of pig iron remained unchanged. How will these differences in quality and output be expressed in the extent of the reduction of the prime costs of the steel produced and, in turn, of the prime costs of marketable output?

At the system currently reigning in ferrometallurgy, the prime costs of the consumed pig iron are transferred in their entirety to the prime costs of the steel produced. Hence although the costs of pig iron in Foundry X remained unchanged, the prime costs of cast steel should decrease somewhat, because the charging of full-value pig iron instead of defective pig iron reduces the outlay of labor in the steel-making department, and it also reduces the consumption of certain ferroalloys added to the charge. In other words, an improvement in the quality of pig iron should also be reflected in a reduction of the costs of marketable output.

In Foundry Y the increased share of defective pig iron in the charges would be adversely reflected in the performance of the steel-making department, even though the pig iron is included in charge costs according to fixed prime costs. Thus processing costs and admixtures of alloys will increase, and hence the unit prime costs of steel will increase, which in turn will also increase the prime costs of marketable output. In this way a deterioration in the quality of the pig iron produced may be properly expressed in the shaping of the prime costs of marketable output.

On the other hand this problem will look quite differently in the case that the sales price system is introduced in interdepartmental turnover. In Foundry X the reduction in the percentage of defective pig iron and the increase in the percentage of full-

value pig iron will cause an increase in charge costs. This is because the sales prices of defective pig iron are (as they should be) lower. Considering that the difference between the sales price of full-value pig iron and the additional costs caused by the use of defective pig iron is (as it should be) sizable, the processing costs in the steel-making department and the costs of charge admixtures will decrease at a lesser rate than will the costs (prices) of charge increase. As a result the statistical reports of Foundry X will indicate an increase in the prime costs of steel and marketable output, and also in the prime costs of total output, which will actually not be the case. Such an increase would be seeming only; it occurred merely because the price of the better quality pig iron is correspondingly higher. In Foundry Y the situation will be just the reverse. At the system discussed the accounting books of Foundry Y will indicate a reduction in prime costs, whereas in reality the quantity of means consumed in the production of steel will have considerably increased.

The introduction of such a system in metallurgical industry might thus lead to an unfair reduction in payments of bonuses to workers in the event of an improvement in the quality of the pig iron produced and, conversely, it would lead to payments of bonuses for thriftiness in cases of waste and squandering. This is because, when bonuses are being assigned, it is not always feasible to carry out a thorough analysis which might reveal whether the savings achieved were apparent only and actually entailed cases of waste and squandering.

Besides it is to be emphasized that such statistical distortions of the level of prime costs in the event of a change in the

quality of charge materials (e.g., if the quality is decreased) occur also when the price difference caused by change in quality does not exceed the additional costs of processing such materials. Let us assume, for instance, that the pig iron produced and consumed by a steel plant has diminished in quality but its production costs remained the same. If the difference in the price of the pig iron equals the additional costs involved in processing such material, the steel plant will not show an increase in the prime costs of the steel it produces. Likewise the statistics and reports of the plant will not indicate an increase in the prime costs of either marketable or total output. Seemingly it might appear that there occurred no increase in the consumption of means of production, but actually this is not so. As a whole, all departments of the plant would then actually expend more means of production and diminish the process of making profit for the plant. However the losses sustained will not be fully reflected in the statistical reports concerning the height of prime costs.

Likewise an improvement in the quality of pig iron would not be reflected in the evolution of the unit prime costs of steel. This is because charge material would then be included in further production at a higher price, although its production costs will not have increased.

It is clear that such a system cannot act as a stimulus for reducing production costs by means of improving the quality of the semifinished products manufactured within an enterprise.

The pricing system currently observed by metallurgical industry gives a more correct picture of the shaping of prime costs. For instance the production of better pig iron contributes to a

reduction of the prime costs of marketable output, and conversely the production of worse pig iron tends to increase such costs. This system also gives a correct picture in cases of purchasing semifinished products from outside. For instance a deterioration in the quality of semifinished products owing to the purveyor's neglect will not affect adversely the evolution of prime costs and profitability in the plants purchasing such products, provided of course that the pricing system for semifinished products considers fully their quality.

The idea of introducing sales prices in interdepartmental turnover is then unacceptable, especially whenever the prices of semifinished products take into account their quality.

From the above described considerations it appears that the height of the reduction of prime costs indicated in the statistics of the textile industry, where such a system has been introduced and where, e.g., the price of yarn varies depending on its quality, is rather questionable.

Returning to the problem of pig iron, it is to be explicitly stated that the only correct solution of the problems touched upon would be to determine the price of the raw material on the level of average prime cost. However it is to be emphasized that average prime cost is construed here not as an average-weight cost but as the prime cost in a foundry selected as standard foundry according to the principles described previously in the section on refractories.

Proceeding on this assumption the determination of the 1956 prices of pig iron was based on the costs in a specific blast-furnace department which has been selected as typical or standard for the Polish metallurgical industry as a whole.

However should the price of every kind and grade of pig iron be fixed at a level equal to its corresponding prime cost?

Actually this would be neither feasible nor correct. This is because processable pig iron is differentiated into as many as about 60 different kinds and grades, and for casting iron the number of kinds and grades is even twice as high. Individual kinds and grades differ from each other in their chemical composition, often very substantially. Moreover sometimes the kind or grade of pig iron obtained differs from the kind or grade desired (usually, is worse), or it may be found that the higher-costing pig iron proves to be metallurgically less valuable than the pig iron whose production cost is lower.

Hence there arises the problem of determining the proper price interrelationship from the viewpoint of the metallurgical value of pig iron. In this case we would designate as pig irons of higher metallurgical value those kinds and grades which in the steel production process require a smaller outlay of labor, fuel, and charge admixtures than the kinds and grades classified as standard ones. On the other hand pig irons of lower metallurgical value necessitate a greater outlay of labor, fuel, and charge admixtures in the steel plant, and hence cause an increase in processing costs. The prices of individual kinds and grades of processable pig iron should be generally so determined that the prime costs of the steel produced would not fluctuate owing to variations in the metallurgical value of pig iron, that is, owing to reasons on which the steel plant cannot exert any influence.

The problem of the proper interrelating of the prices of individual kinds and grades of pig iron arises also when the prices

of pig irons are not generally at the level of their prime costs. Therefore a correct interrelation of pig iron prices may be expressed by the following formula:

$$\frac{P_1}{P_o} = \frac{K_o + E_1}{K_o}$$

where P_1 is the price of given kind and grade of pig iron;

P_o is the price of standard grade of pig iron;

K_o is the prime cost of standard grade of pig iron;

E_1 is the change occurring in the prime costs of the production of a ton of steel in the event that the standard grade of pig iron is supplanted by a grade of iron whose price is denoted by the P_1 symbol; this magnitude (determined according to empirical data) may be either positive or negative -- positive when the pig iron has a higher metallurgical value than the standard pig iron, and negative when vice versa.

There exists a more advanced formula for this relationship, which we will term composite relationship to distinguish it from direct relationship based on prime cost (and described in the section on refractories), and which has the following aspect:

$$\frac{P_1}{K_o + E_1} = \frac{P_o}{K_o} = S_z$$

where index S_z is the index of composite relationship, expressing the price level of given commodities, fixed by the appropriate economic authorities, in relation to the prime costs of their production.

Until 1955 inclusive this index was below 1.0 so far as pig irons were concerned. The 1956 price list adopted an index of 1.0, which also signifies that the expectations of a 5% profit were

relinquished, in general. This is because it would not be expedient to add to the burden of prime costs of the steel plants consuming pig iron purchased from the outside by providing for profits for the foundries producing and selling such iron to these plants. Moreover in a number of foundries this is of no practical importance because the prime costs of their pig irons may deviate somewhat from their sales prices. If these costs go down the foundries attain some profits, and if they go up there are some losses sustained.

Speaking of profits, it is also to be stated that it is not always expedient to add the profit margin to the prime costs of production when determining the price of a given product, especially when we expect that within a relatively brief period prime costs may be considerably reduced. In such cases the fixing of the composite relationship index at the level of $S_z = 1.05$ might cause a wholly unnecessary and unintended accumulation of monies in industrial enterprises which have not been created chiefly for such a purpose. This would unnecessarily complicate the system of collecting the monies accumulated by industry.

A change of prices in order to counteract such effects is not always advisable: frequent changes in prices should be avoided because they entail the necessity of revising the distribution of means in national economy, and this requires unusually labor-consuming analyses and calculations.

The formula for determining the price of a specific grade of pig iron (as resulting from transposing the above cited formula) is as follows:

$$P_1 = S_z \times (K_o + E_1)$$

If it be assumed that S_z equals 1.0, then $\frac{P_o}{K_o}$ would also equal 1.0, and hence:

$$P_1 = K_o + E_1$$

Pig iron of the M1 kind, Grade 1 (containing 2.0% manganese and 0.5% sulfur) was adopted as the standard pig iron when determining the 1956 prices. The cost of this pig iron is denoted in the above formula by symbol K_o, and its price, in the preceding formulas, by symbol P_o.

In order to determine properly the prices of individual kinds and grades of pig iron it is necessary to have a reserve of empirical data making it possible to determine the fluctuations in steel-plant costs owing to changes in the kind or grade of the pig iron used. The lack of a sufficient quantity of such data during the drafting of the 1956 price list has caused the necessity of employing certain simplified preliminary estimates, with chief attention devoted rather to the transparency of the tabular arrangement of the price list (e.g., with respect to open-hearth pig iron, if the sulfur content changes by 0.01% but the norm is not thus exceeded the price per ton changes by 20 zlotys). The prices of the various kinds and grades of foundry pig iron (at varying contents of sulfur) have been likewise determined, with the price of the standard grade for every kind of pig iron being based on prime costs.

The determination of the proper height of E_1 for individual grades of pig iron will still require a number of additional studies whose results may be utilized at a subsequent change of pig iron prices.

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The new pig iron price list for 1956 contains considerable economic incentives for raising the quality of the pig irons produced. The prices of defective pig irons were fixed at 70% of the price of the cheapest good-quality grade of a given kind of pig iron. In this connection, it was assumed that faulty pig irons containing an excessively high (in relation to reigning standards) amount of harmful impurities (especially sulfur) should be generally regarded as defective products. If however a purchaser consents to accept such pig irons he should receive them at a much lower price than that of good-quality iron. On the one hand, the producer will thus be impelled to raise the quality of his output to avoid the considerable losses involved in selling defective pig iron and, on the other, the purchaser will be thus enabled, by paying lower prices for defective pig iron, to defray the additional expenses involved in its sintering. Here it is advisable that the price difference between defective and good quality pig irons should exceed the additional sintering costs. In this event the purchaser will become more interested in buying and consuming defective pig iron; and this is very important because from the economic point of view it is more profitable to use defective pig iron in a steel plant than to resmelt it in a blast furnace.

The origin of the 70% index should be also explained. Namely, this is quite commonly accepted throughout industry as the ratio of the prices of usable defective products to their corresponding full value products. True enough this is a conventional (contractual) index, but in this case it is regarded as effective enough for discouraging blast furnace workers from producing defective pig iron. However it is also to be noted that the height of that index cannot be fixed arbitrarily. Such an index is determined, on the one hand,

by the value of the original raw material from which the product is created and, on the other, by the additional costs borne by the purchasers owing to the utilization of defective material.

In this concrete case the price of defective pig iron should not be fixed at a level low enough to make it profitable to use such iron as charge for blast furnaces. Neither should the price be fixed at a too high level because then the difference in the prices of full-value and defective pig irons would not be high enough for defraying the additional costs caused to a steel plant by the necessity of burning out the excess harmful impurities in defective pig iron.

To determine the lower price limit, it is necessary to calculate the chemical composition of defective pig iron in the terms of the indexes adopted for computing the metallurgical value of ores. For instance in 1956 the price of defective M1 pig iron containing 92% Fe, 2% Mn, 1.5% Si, 0.15% S, and 4.35% C, should not be lower than:

92.00 x 6.20 zlotys =	+ 570.40 zlotys
2.00 x 15.00 zlotys =	+ 30.00 zlotys
1.50 x 5.60 zlotys =	- 8.40 zlotys
0.15 x 6.70 zlotys =	- 1.00 zlotys
Total	591.00 zlotys per ton

The upper limit of the price of defective pig iron is determined by the price of standard full-value pig iron decreased by the additional processing costs caused by the increased consumption of materials, reduced human labor productivity, and reduced machinery productivity involved in the sintering of defective pig iron. The maximum price of defective pig iron having the above mentioned

chemical composition should not -- it appears -- exceed 880 zlotys per ton. The 1956 price list materializes the above postulates. The price of defective M1 pig iron containing more than 0.1% sulfur amounts to 685 zlotys a ton, and the upper limit of sulfur content is not fixed. This ensues from the assumption that steel-plant men would willingly sinter pig iron with a sulfur content of even more than 0.15% because the difference between the upper price limit (which just about suffices to assure the steel plant of defraying the additional processing costs) and the actual price is attractive enough to them. On the other hand, blast-furnace men would not find it profitable to use defective pig iron as blast-furnace charge because its price is higher than should be in relation to the price of ore.

2. Cast Steel

General characteristics of steel classification. Group prices. Pertinency of the surcharge and discount system. Surcharges for metallurgical certification and technical reception.

When determining prices we have often to deal with commodities manufactured in a very wide range of forms. Practical considerations sometimes make it necessary to limit the number of price-list items and to apply a single price to a number of forms of a given product. The result is the so-called group prices [see Note]. This section constitutes an attempt at describing -- with steel prices as the example -- the circumstances necessitating the establishment of group prices and the method of determining such prices.

(/Note/ There exists a substantial difference between the concept of "group prices" and the often applied concept of "mean group prices." Whereas the former pertains to the single price of a number of forms of a product, the latter pertains to the weighted mean of the various prices in a group of products, each of these prices being different from another.)

First of all it is to be emphasized that the colloquially applied differentiation between "iron" and "steel" is incorrect from the technological viewpoint. This is because here we are merely dealing with diverse kinds or grades of steel. On the other hand, it is correct to differentiate between ordinary and quality steels.

Ordinary steel occurs in over 120 kinds, and quality steel in about 400 kinds (not counting the many forms of nonstandard quality steels manufactured to special order).

Therefore for practical purposes steel has been divided into grades, grades into subgroups, subgroups into groups, and groups into classes. This classification is based on the decimal system.

According to the regulations effective since 1 October 1954, ordinary steel is included in Class 1 (first). On the other hand, quality steel is graded in 4 classes -- 2, 3, 4, and 5 (structural, tool, special, and nonstandard steels).

Let us illustrate this classification by means of a brief example.

Class 2 (structural steels) contains Group 21 (structural alloy steels with no nickel in them) which in turn contains

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Subgroup 210 (silicon steels for the manufacture of dynamo and transformer plates). This subgroup is in turn divided into 2 grades: 2100 (silicon steels for the manufacture of dynamo plates) and 2101 (silicon steels for the manufacture of transformer plates).

Grade 2100 contains these kinds of steel: BS05, BS10, BS20, BS25, and BS30, and Grade 2101 -- BS38 and BS40. The individual forms differ from each other in chemical composition and mechanical properties.

Now there arises this problem: should the price list for steel and rolled steel products be based on the above described classification into grades, groups, etc, which is applied in production, supplies, sales, planning, and reporting?

Here we will deal solely with ordinary steel (Class 1) because the problem of the prices of quality steels will be discussed separately later on.

The above described classification was drafted from the viewpoint of the suitability and adaptability of every individual type of steel for specific purposes, without taking into account the production costs. It may thus be found that a given group of steels may comprise subgroups with sharply varying prime costs of production. Hence the necessity of classifying steels in the price list in a somewhat different way. In this connection the following reasoning has been followed.

The over-all level of cast steel prices as well as of the prices of nearly all metallurgical products should in principle correspond to the prime costs of their production. The reason for

this has been explained in the preceding chapter. What remains to be explained is the problem of price interrelationship, i.e., in this case the problem of the relations among the prices of various types of cast steel in Class 1.

The most correct solution here would be to apply the principle of direct relationship. This is because in contrast to pig iron cast steel is designed for diverse purposes depending on its chemical composition, structure, and mechanical properties. Besides the selection of a relationship that would not correspond with the dynamics of prime costs might cause the underfulfillment of the plants for the range and variety of output. This is because steel plants would then be interested in manufacturing the types of steel that assure the highest profits or the least losses.

At such a situation it might seem that it will suffice to compute the prime costs of each type of steel in Class 1 and to fix the sales prices according to the direct-relationship formulas cited in the preceding chapter. However an additional difficulty arises here. If the price of every grade of steel were determined separately, over 120 different sales prices would exist for steels in Class 1. This would not be advisable considering that cast steel is merely a semifinished product and constitutes the raw material for rolling mills. Otherwise it would be also necessary to determine a tremendous quantity of prices for every type and type-size of rolled product (in certain cases, as many as 100 prices), depending on the grade of steel out of which it is manufactured.

Practical considerations required, therefore, the fixing of group sales prices for cast steels in the 1956 price list. All grades with similar prime costs were comprised in a group, and there

were altogether 9 such groups, denoted by letters A, B, C, D, E, F, G, H, and I; thus any grade of steel comprised within a given group is sold at the sales price fixed for that group. In this way 2 effects have been achieved: the number of price list items has been reduced and at the same time it became possible to fix the sales price of every grade of steel at a level approximately corresponding to its prime cost. As can be concluded from the above price list groups have, of course, not much in common with the groups in the classification of metallurgical products (except for Group "I" -- steel for pipe manufacturing). This is because price list groups are compiled from the viewpoint of the prime costs of the steels they comprise, whereas the metallurgical classification is based, as noted before, on the specific uses of individual grades of steel. In view of the planning needs it would be worthwhile to arrange the price list groups of steels in such a way as to make it possible to determine easily the mean group price.

The price list of cast steels for 1956 comprises prices for dressed and nondressed ingots, and the difference between the 2 is minimal considering the smallness of the surcharge (15 to 20 zlotys, depending on the steel group) payable for dressing. This is of dubious efficacy considering that thus the steel plants do not receive sufficient encouragement for delivering ingots in a dressed state. It would be also worthwhile to consider that a sizable part of defects in ingots is not revealed until they are dressed, and this is another factor discouraging the steel plants from carrying out this operation, because rejection of ingots by the steel plants themselves would mean a decrease in the fulfillment of their plans.

A major component of the pricing system in metallurgy is the widely applied system of surcharges and price discounts. Surcharges fulfill generally a 2-fold role.

(1) They contribute to reducing the bulk of the price list and simplify its reading because, e.g., specification of receivable and unreceivable type-sizes, with or without certificate, is eliminated in favor of citing the prices of basic type-sizes (without taking into account any additional wishes of the purchasers) plus percentile or numerical surcharges, in absolute figures, for technical reception or metallurgical certification.

(2) They create additional economic incentives for an optimal utilization of the production potential of steel plants. This is because in many cases steel plants are "snowed under" by additional specifications sent in by purchasers who pose qualitative or dimensional requirements that are not always necessary from the technological or economic point of view. Very often the purchaser is simply concerned about reducing the number of operations in his own plant, without considering that this may add to the expenses to the steel plant and hamper its productive capacity. It may be boldly stated that if all purchasing plants confined their qualitative and dimensional requirements to the minimum, the output of the processing departments of metallurgical industry would increase considerably. True enough certain purchasers are not even scared off by the surcharges demanded by steel plants for the additional processing, but it is to be expected that the further advance of the struggle for the reduction of production costs will stimulate them to drop their unjustified demands.

The purpose of price rebates or discounts is essentially to mobilize metallurgical industry in the struggle for increasing the quality of production. This is because discounts pertain to second-class and defective products. Likewise the prices of utile hardware in the group of metallurgical wastes and rejects are based on the rebate system. This problem will be described in greater detail later on.

With respect to cast-steel ingots, the price list specifies only 2 types of surcharge -- for metallurgical certification and for technical reception, similarly as in the case of semifinished metallurgical products.

By issuing a certification the steel plant guarantees the proper quality (chemical composition and mechanical properties) of its product. However this alone is not enough. The certified product should be inspected as to its quality by the steel plant, and subjected to proper laboratory examinations. In this connection there arises the danger that these investigations may cause the commodity to be disqualified and classified in a lower quality group. In this event the steel plant will sustain a loss. Therefore the fee for metallurgical certification comprises not only the expenses on the inspection of quality and suitability but also any eventual losses that might be sustained if a part of the certified output has to be declassified.

Seemingly these solutions might appear as unfair and somewhat sanctioning any neglects and dishonesty of the steel plant. In practice, however, the matter looks otherwise. If the fee charged for technical reception or metallurgical certification were to comprise merely the expenses on the inspection of quality and

suitability, its height would be too small in relation to the price of the product. Then purchasers would have no motive for desisting from asking for metallurgical certification or technical reception, and the demands posed to the steel plant would not always be economically justified. This matter cannot be regulated administratively, because of the excessive multiplicity of the conditions and circumstances in which steel is used. Therefore it is necessary to apply appropriate economic incentives, which in this case means a high surcharge fee.

It appears also that the struggle for a high quality of metallurgical production should not consist in reducing the fee for certification or technical reception. It should be rather concentrated on the system of price discounts for second-class products and rejects. In addition it appears expedient to base the system of bonusing for the fulfillment of output plans also on the quantity of declassified products as revealed during technical reception.

With respect to metallurgical products surcharges for both metallurgical certification and technical reception are generally expressed in sums of money (zlotys) per ton, except in cases of the prices of pipes and quality steels where these surcharges are expressed in percent, and in the cases of rails and other parts of railroad surfacing, where they are included in effective prices.

This principle was established because it was found desirable that the prices of the qualitatively higher and more expensive grades entail lower percentile surcharges for certification or reception than the prices of the lower grades. Besides it is understandable that the purchasing plants which must use high-grade steels may have objective reasons for desiring to examine the

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mechanical properties of such steels, whereas this is not as valid with respect to lower grade steels.

3. Semifinished Rolled Products and Rolling Mill Products

Semifinished rolled products. Units of relationship adopted in determining the prices of semifinished steel products. Adverse effects of a uniform price for a number of sizes with different production costs. Grouping type-sizes according to the time of rolling per ton. Grouping type-sizes according to hourly productivity. Change of mean weighted prime cost in calculation group owing to change in variety of output. Normed prime costs of the production of individual type-sizes. Scope of the products of rolling mills. Relationships among mean weighted prices of calculation groups. Relationships among prices of products within a given calculation group. Relationships among the prices of identical type-sizes executed from diverse grades of steel. Trends for a revision of the current method of determining the prices of rolled products. Prices and theoretical weight of products. Surcharges for "unsuitability." Surcharges for small quantities. Surcharges for specific length. Surcharges for accurate rolling.

This section serves to discuss further the problem of the prices of products manufactured in a wide range of forms, with semifinished rolled products and rolling mill products as the example. Among the major problems discussed here the ones most interesting to the reader might be: determining the scope of the range and variety of a product which is to be comprised within a given price

list position; determining prices on the basis of normed prime costs of individual assortments of products; and the problem of relating the prices of products to their theoretical weights.

Rolling is at present the most widespread method for the plastic processing of the steel cast in ingots. The other forms of plastic processing, such as forging and stamping, are applied to a considerably smaller extent. Suffice it to say that at present about 95% of all finished products of ferrometallurgy are treated in rolling mills. Rolling serves to confer upon steel specific shapes and appropriate dimensions. Rolling also serves somewhat to improve the mechanical properties of steels because it alters their original internal structures.

However rolling mills rarely use cast steel in ingots as the charge, because these mills can process directly small ingots weighing several hundred kilograms. The casting of small ingots hampers an increase in the output of steel plants, and therefore production is rather concentrated on large ingots weighing 5 to 8 t which are then subjected to the first stage of rolling and emerge as semifinished products which are later finish-rolled. Small ingots still continue to be used (although not exclusively) as charge in pipe mills.

The semifinished rolling products, i.e., products of the first stage of rolling, are chiefly blooms of square or rectangular cross-section, rolled from large ingots. Such products also include certain semifinished products rolled in large mills and subject to further treatment in other mills. They include the so-called billets and rods for the production of pipes. A special group of semifinished products is constituted by plate, which is manufactured

from small, flat ingots, slabs and flat billets, and later on processed into sheets.

Semifinished rolled products are used exclusively as charge in rolling mills, but nevertheless they occupy a major role in the marketable output of many steel plants and are part of interplant turnover. Therefore a proper determination of the prices of these semiproducts is of great importance to economic accounting in steel plants and to a correct appraisal of their efficiency.

The proper determination of the price level of semifinished rolled products necessitates solving these problems:

(a) methods of determining price interrelationship;

(b) ratio of price level to prime-cost level;

(c) scope of units of relation to specific list prices (price-list sizes).

As in the case of cast steel, the determining of the interrelationship of the prices of semifinished rolled products requires the application of the principle of direct relationship, $\frac{P}{K} = S_p$. This is motivated by the same considerations as in the case of cast steel (see page 85). Therefore the 1956 prices were based on a direct relationship index of $S_p = 1.0$ expressing the ratio of price to prime cost.

A much more difficult problem is how to determine the scope of price-list type-sizes (units of relation to prices) for semifinished rolled products. It appears that a correct solution of this problem should follow the reasoning given below.

Proceeding on the assumption that in the case of semifinished rolled products the principal cost factors are generally proportional to the operating time of the blooming mill (save for the amortization costs, which are rather related to calendar time), it should be assumed that the cost of rolling a ton of a given steel should be directly proportional to its rolling time. In practice this is not always true because there may occur deviations connected with the index of utilization of calendar time, changes in the consumption of electric power, etc -- however in this case these factors may be overlooked. This is because any further attempts to attain a still greater accuracy in computing the relationship between rolling time and prime cost might only lead to confusion and the essence of the problem might get lost in the forest of details.

Speaking of the problem of the relationship between rolling time and prime cost of semifinished rolled products, it should be emphasized that the type-sizes of blooms whose prices are fixed at diverse levels should comprise cross-sections with the most similar rolling time per ton. The number of such type-sizes needs not be equal to their catalogued number, because changes in the blooming coefficient and in speed of rolling (which are possible within certain limits) may cause a number of diverse cross-sections to have identical (or very similar) rolling time per ton.

Metallurgy employs a concept termed "rolling cycle" which serves to determine the time necessary for bringing a given piece under the rollers, rolling it and removing it. Now if the rolling time per ton of blooms with varying cross-sections is to be identical, the average rolling cycle for these cross-sections should be inversely proportional to the number of pieces of which a ton of blooms of a given cross-section is composed.

Assuming that all the blooms with diverse cross-sections have an identical length, it is to be assumed that a given type-size comprised in the price list should comprise cross-sections with mutually equal quotients of cross-sectional area and rolling cycle.

This may be represented by the following formula:

$$T_c(_o) \times q(_o) = T_c(_1) \times q(_1) = T_c(_2) \times q(_2) = T_c(_n) \times q(_n)$$

where: $(_1)$, $(_2)$, $(_n)$ = individual catalogue items, by cross-section;

T_c = rolling cycle of given cross-section;

q = area of given cross-section.

There exists also another criterion for grouping products within individual price-list type-sizes. This is the theoretical hourly output of a product, which may be represented by this formula:

$$P_t = \frac{36,000}{T} \times G \times u, \text{ tons/hour}$$

where: P_t = theoretical hourly output of a given product;

T = rolling rhythm (in seconds);

G = weight of charge (in tons);

u = yield.

(Rolling rhythm stands for the time between 2 corresponding stages of rolling 2 successive pieces, for example, time between clamping a bloom, processing it, releasing it, and clamping another bloom. See K. Filasiewicz, Technologia metali -- zarys hutnictwa zelaza i metali niezelaznych /Technology of Metals -- Outline of the Metallurgy of Iron and Nonferrous Metals/, 1954, Mining and Metallurgical Publishing House, page 266.)

Analogous solutions may be applied to other forms of semi-finished rolled products (billets, plates, and rounded rods for pipe manufacturing).

Whether the choice falls on the first or on the second solution it must in either case be preceded by selecting as standard one of the blooming or slabbing mills and one of the billet-and-rod mills, in order to determine the theoretical hourly output or rolling cycle in the manufacture of various products.

In this case the adoption of mean weighted values for all such plants in ferrometallurgy as a whole would excessively complicate and distort the relationships among individual price-list items, especially when the share of individual plants in the total mass of output would change.

Hence the plants to be considered should be the most modern ones that have the highest possible share in the output of semi-finished products of a given type.

In the 1956 price list the problem of determining the scope of type-dimensions has been solved thus: with regard to all square and rectangular blooms, their prices were differentiated solely according to (price-list) groups of steels, regardless of cross-section. For instance in Group C (21 grades of steel), all nondressed blooms with square cross-section and a thickness of 120 to 300 mm, and all nondressed billets of rectangular cross-section which are also produced in diverse sizes, have a uniform fixed price of 1,590 zlotys a ton. The dressed blooms are priced in the list at 15 zlotys more per ton.

The situation with regard to plate metal is similar, as there the prices for the corresponding steel groups are differentiated solely depending on whether the plate is cut into pieces of a specific length or is sold in uncut strips. On the other hand it was

completely overlooked that plate occurs in diverse thickness and has 6 different widths.

The prices of square billets were determined at 2 levels for every steel group (not counting the dressing surcharges):

(a) billets up to 50 mm thick (in 2 catalogue dimensions);

(b) billets 50 to 120 mm thick (10 catalogue dimensions).

With respect to rounded blooms and billets, which the price-list terms rounded rods for pipe manufacturing, their prices were differentiated only depending on grade of steel, without considering that these rods are manufactured in 14 catalogue thicknesses (from 11 to 300 mm).

It is indubitable that such simplifications considerably ease the using of the price-list. On the other hand their correctness seems dubious if considered from the viewpoint of their influence on economic accounting. After all it is obvious that the rolling of a 120-mm thick bloom requires a considerably greater outlay of labor than in the case of a 300-mm thick one. Hence the processing costs per ton of blooms with smaller cross-section are higher than per ton of blooms with larger cross-section. If then a uniform price be introduced for all blooms in a given steel group, regardless of cross-section, the steel plant marketing these blooms to the outside will become more interested in rolling the blooms with the largest cross-section. This cannot but affect the range and variety of its output. As a result it may happen that there will be a scarcity of blooms with smaller cross-sections (purchasers will not be supplied adequately) and a glut of blooms with larger ones.

Besides there arises the question of the form of the prime costs of bloom production on which the price should be based.

Let us assume for instance that a given foundry rolls blooms of varying cross-sections -- from 120 to 300 mm -- partly for its own rolling mills and partly for other foundries. If the price of the marketed blooms is fixed at the level of the mean prime cost, the purchasing plant, which is bound to receive mostly the thicker cross-sections, overpays for them as much as is gained by the delivering plant which retains the thinner cross-sections for its own rolling mill. It would be also worthwhile to note that a steel plant which includes its thinner bloom cross-sections in its further production at mean weighted costs thereby artificially reduces the prime costs of its own finished rolled products, whereas the steel plant receiving thicker cross-sections at the same price as thinner ones is bound to increase as much the prime costs of its finished rolled products.

The same effects may be caused by determining uniform prices for a number of sizes of other semifinished rolled products (billets, slabs, and rounded rods for pipe manufacturing).

As can be concluded from the above, the price list for 1956 has not solved properly the problem of determining the scope of the type-sizes of semifinished metallurgical products. In the future this scope should be so determined that every type-size would comprise products with the most similar prime costs.

Following the above discussion of methods for determining the scope of type-sizes of semifinished rolled products, it is necessary to return to the matter of costs on which the sales prices of individual type-sizes are based.

The normally applied costing pertains to the mean weighted planned or resultant prime costs for an entire (calculation) group of semifinished products of a given type, and hence it pertains to a number of catalogue items. It would seem that the problem would be simplified if the number and scope of price-list type-sizes were to be made equal to the number and scope of calculation groups comprising given products - this being the case in the 1956 price list. However this is not so because another problem arises therefrom. The height of the mean weighted unit cost, no matter whether it is of a planned or of a resultant nature, is inseparably related to a specific share of each of the semifinished products (of diverse catalogue dimensions) in a given calculation group. If the extent of this share changes, which will involve a change in the mean weighted prime cost, then the price, being based on the original cost, may deviate considerably from the actual prime cost.

The solutions adopted when determining the 1956 price list have also ignored this problem, although it is of some importance to economic accounting.

As noted before, there is not much reliability in the method of determining the prime costs of individual price-list type-sizes on the basis of the mean weighted prime cost of a calculation group as a whole and of estimating this cost according to a specific key for the given type-sizes. This applies especially to products with such a wide range and variety of output as rolled products. The only correct method would seem to be determining the normed (theoretically computed) height of unit prime cost of every individual type-size. This may be carried out as follows:

(1) cost of direct materials = price of charge x quantity of charge (returnability of yield);

(2) processing costs = $\frac{X}{P_t}$, where X = labor cost plus departmental costs per hour of operation of a given plant assembly (at continuous operation) (processing costs may also amount to $\frac{X + a}{P_t}$ if a given type-size requires additional staffing of plant assembly, where a = cost of additional labor per hour of plant-assembly operation plus appropriate additional departmental costs); in this case labor costs are estimated according to schedule of rates and departmental costs according to the outlay of labor indicated in statistics, P_t = theoretical hourly output of a given type-size;

(3) the additional all-plant costs and marketing costs are determined according to the generally adopted principles;

(4) unit costs also are decreased by the value of wastes, as follows: price of scrap in zlotys per ton x (W - 1 ton), where W = charge in tons.

Let us now pass over to a discussion of the products of cogging mills /see Note/. In the catalogues, the concept of products rolled in cogging mills comprises a great variety of products of diverse shape and size, such as rounded rods, square and flat rods, hectagonal rods, semiellipsoid and trapezoid rods, circular and semicircular bars, equibranchial angle sections, C-sections, T-sections, I-sections, Z-sections, rails, and diverse other fittings.

(/Note/ The name "cogging mill" derives from the shape of the beams -- part of roller in direct contact with the metal rolled. In rolling mills with smooth beams the output consists of flat blooms and universal, thick and thin sheets. But in rolling mills

with rollers the beams of which are grooved out (cogging mills) the output consists of rods and fittings of other forms. The crusher of the blooming type may also be included among cogging mills in view of the shape of its roller beams. Hence the differentiation inherent in the name is technologically incorrect but is used to conform to the universally adopted commercial terminology according to which semifinished rolled products designed for further processing in rolling mills and forges are not included among the products of cogging mills. See Katalog wyrobow walcowanych oraz pretow ciagnionych, luszczonych i szlifowanych [Catalogue of Rolled Products and Drawn, Peeled, and Polished Rods], 1953, Polskie Wydawnictwa Gospodarcze Publishing House, page 13.)

The 1956 prices of rolled steel products were thus determined: the starting point was the calculation of the prime costs of these products according to calculation groups, upon taking into account any changes in the prices of charge materials, fuels, scheduled rates for electric power, amortization rates, transport rates, etc. This then served as the basis for determining the mean weighted prices of calculation groups. The mean weighted prices served, in turn, for determining the specific sales prices of individual type-sizes within each calculation group.

These labors also involved the prior review of the relationships among the prices of individual calculation groups, although only in a superficial manner, with attention being devoted only to an appropriate increasing of the prices of the groups comprising the more labor-consuming products.

The question is: is the computing of the mean weighted prices of calculation groups at all necessary when preparing the price list? Apparently it is not always necessary.

If the price of each type-size is determined on the basis of the normed prime cost (even if through the above cited method), the computing of mean weighted prices may be discarded. Such prices would be useful only to the purchasers when they desire to recalculate their plans of supplies according to new prices. Such plans may be also recalculated according to indexes expressing the ratio of old prices to new ones for the most typical (standard) products in given calculation groups. However the method applied for determining the prices of rolled products in 1956 involved the necessity of being familiar with the mean weighted prices of individual calculation groups. Hence it was also necessary to examine the correctness of the relationship among the prices of these products. Incorrect relationship is, in the case of direct relationship, construed as a disproportion between the prices of 2 and more groups and the actual prime costs of the production of type-sizes with the highest specific weight in these groups.

If we overlook any eventual errors in the computing of the mean weighted prime costs of given calculation groups, these disproportions may arise in principle only at the existence of large differences among the percentile shares of principal type-dimensions in these groups. If appropriate measures are not undertaken there may arise the danger that the concrete prices of individual type-sizes, as resulting from the application of the mean weighted group price, may be determined at an incorrect level, especially when there are no statistical data pertaining to the percentile share of individual type-sizes in these groups.

It appears that the examination of mean weighted group prices should involve not only a study of the correctness of calculations

but also a comparison of the evolution of prime costs of group "representatives," or at least a comparison of the quantity of labor required by the manufacture of principal type-sizes ("representatives") in individual groups. The last has been made in the course of, not prior to, the drafting of the price list.

If during this examination it were concluded that the production structure within individual calculation groups distorts the intergroup relationship, the estimates should take into account the percentile shares of individual type-sizes within each group instead of correcting the mean prices of calculation groups as was the case before.

The breakdown of the mean prices of calculation groups into prices of diverse types and dimensions of types was made upon taking into account the outlay of labor (labor consumption) involved in the manufacture of each type-size. The following parameters were considered:

(1) hourly productivity for the manufacture of a given type-size (in tons per hour of plant-assembly operation);

(2) the so-called recalculable number of workers employed in the technological process of rolling (in rolling-mill assemblies, finishing mills, operation maintenance, and auxiliary teams) per working shift;

(3) yield in percent.

With these parameters as the basis, the following fundamental formula has been established for computing the interrelationship of the prices of individual sizes and types:

$$K = \frac{\text{hourly productivity of rolling mills x yield of finishing mill}}{\text{"recalculable" number of workers}}$$

After the "K" coefficient was determined for individual type-sizes, its reversibility (K_1) was computed. This reversibility may be accepted as standing for the labor-consuming capacity of the production process for these types and dimensions:

$$K_1 = \frac{1}{K} = \frac{\text{"recalculable" number of workers}}{\text{hourly productivity of rolling mills x yield of finishing mill}}$$

Next, out of the products of cogging mills one product with specific dimensions and profile was selected as the most characteristic or standard one. It was given an index of 100 and all other products of cogging mills were arranged in relation to it, with the index R_1 being determined for each according to this formula:

$$R_1 = \frac{K_{1n} \times 100}{K_{1-o}}$$

where: K_{1n} = K_1 index of the given product,

K_{1-o} = K_1 index of standard product having the index of 100.

In turn, the relationship among the prices of individual assortments of rolled products, prices comprised in calculation groups, was determined as follows.

The lowest R_1 index in a given calculation group was assumed at 100 and the R_1 indexes of the other products in the group were arranged in relation to it.

This was carried out according to the following formula (by determining the R_2 index of each product in the group):

$$R_2 = \frac{R_{1n} \times 100}{R_{1-o}}$$

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where: R_{1n} = R_1 index of given product in the given group

R_{1-o} = R_1 index of product assumed at 100

In this connection it was assumed that the R_2 index evolves in direct proportion to the normed processing costs of a given product. In regard to material costs, it was assumed that the cost of charge material for all products in a given calculation group is the same, and that it accounts for 80% of the total prime costs of every cogging-mill product. Proceeding on these assumptions the ultimate index of the relation of each product in a given calculation group to the standard product in that group was determined by means of the following formula:

$$1,000 + (R_2 - 100) \times 2$$

In this way the following values were computed for, e.g., product (profile) X (calculation group):

(a) thickness 16 to 19 mm relationship coefficient 1,192

(b) thickness 20 to 21 mm relationship coefficient 1,146

(c) thickness 22 mm relationship coefficient 1,118

(d) thickness 24 to 30 mm relationship coefficient 1,100

(contractual data)

The problem is now how to determine the specific prices (expressed in zlotys per ton) of individual sizes of Product X upon being familiar with its mean cost (and hence also mean price) and with the above cited relationship coefficients.

It is to be kept in mind that Product (profile) X is manufactured not only in varying thickness but also from various grades of steel which are included in several different price-list groups.

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Hence, first of all, it is necessary to compute, or -- in the event of the absence of appropriate statistical data -- estimate the mean price of the basic price-list Group (of steel grades) A.

Let us therefore assume that the mean price of Profile X amounted to 2,250 zlotys a ton, and that in the A Group of steels in the price list that Profile was listed at 2,188 zlotys a ton.

Thereupon, with the help of statistical data or estimates, it is necessary to determine the percentile share of each thickness of Profile X in the total tonnage of the output of Product X from the grades of steel comprised in the price-list Group A. The existence of such statistics would stagger the imagination. Therefore there is nothing surprising in that these magnitudes have to be merely estimated.

Let us further assume -- in our given example -- that the share of individual thicknesses of Profile X in the total tonnage of its output from the steels comprised in price list Group A is appraised on the basis of the following estimate:

(a) thickness 16 to 19 mm	20%
(b) thickness 20 to 21 mm	30%
(c) thickness 22 mm	10%
(d) thickness 24 to 30 mm	40%
Total	100%

Therefore the subsequent calculations would be as follows:

(a) 1,192 x 20 = 23,840

(b) 1,146 x 30 = 34,380

(c) 1,118 x 10 = 11,180

(d) 1,000 x 40 = 40,000

Total 109,400 points, which corresponds to the value 2,188 zlotys x 100 = 218,800 zlotys.

Therefore, 1 point = 2 zlotys.

Accordingly the price of a ton of Profile X in price list Group A will amount to:

(a) thickness 16-19 mm 1,192 x 2 zlotys = 2,384 zlotys

(b) thickness 20-21 mm 1,146 x 2 zlotys = 2,292 zlotys

(c) thickness 22 mm 1,118 x 2 zlotys = 2,236 zlotys

(d) thickness 24-30 mm 1,100 x 2 zlotys = 2,000 zlotys

There arises the question: how to determine the prices of individual dimensions (thicknesses) in the other price list groups of steels?

The 1956 price list did it in a very simplified manner; first by determining the indexes of relationship among steel groups, e.g.:

C:A = 104.25:100

D:A = 106.40:100

E:A = 117.00:100

G:A = 122.35:100

etc.

These indexes correspond approximately to the relationships among the manufacturing costs of diverse grades of steel comprised in these groups.

Upon multiplying the prices of individual type-sizes of Group A by these indexes of relationship it was possible to determine

the 1956 list prices of the corresponding type-sizes in the other price-list groups of steels.

This, of course, is not quite correct because the processing costs of a specific type-size made of higher-grade steel do not necessarily increase in direct proportion to the increase in charge costs. Frequently these processing costs may remain at an identical, unchanged level.

As can be concluded from the above, the methods applied for determining the prices of cogging mill products in 1956 have been very labor consuming and not wholly consistent. This was because of the excessive number of estimates and simplifying assumptions, aside from the overly complicated calculations of certain values.

As was emphasized before, the prices of individual type-sizes should be so determined as to be directly proportional to their manufacturing costs. This is to avert a situation in which the sales prices of the more expensive and labor consuming type-sizes would not be commensurately higher and, as a result, the profit of the steel plant would be reduced. It is clear that in such a case the steel plant would curtail as much as possible its output of certain profiles and sizes in favor of others, and the purchasing plant, in order to avoid stoppages in its operations, would have to accept substitute profiles of greater size. As a result there would occur a decrease in the labor productivity of the purchasing plant and an increase in the labor consumption of its products; also consumption of metals and the material costs would both rise. This phenomenon has recurred very frequently in the machine building industry, and it may be assumed that it has been caused by,

among others, the improper relationships of prices within individual groups of metallurgical products.

Excessively high prices of certain profiles and sizes -- and eventually grades of steel -- also are unfavorable because they lessen the interest of steel plants in manufacturing other, cheaper profiles and sizes.

Now the method applied in determining the 1956 prices of rolled products does not insure the obviating of certain disproportions between the evolution of prices and prime costs of individual type-sizes. Nonetheless the use of this method signifies tremendous progress compared with the preceding years when -- owing to the absence of any special concept -- the relationships among prices within individual groups of metallurgical products were the result of mere arbitrary decisions.

The concrete (although secondary) advantages which the application of this new method brought to ferrometallurgy consists in that the determination of prices was accompanied by the examination or reanalysis of the hourly productivity of mill assemblies and the labor-consuming capacity of diverse rolled profiles and sizes in a number of steel plants. There is not a grain of doubt that the data thus obtained would be very suitable for production-planning purposes and for the distribution of output targets among individual plants.

It appears that in the future the following postulates should be adopted for determining the prices of rolled products.

Considering that the ferrometallurgical industry does not plan nor break down the manufacturing costs of the individual

profiles of rolled products in all the list-priced sizes and groups of steels, neither planned nor resultant calculations can be employed in price determination. Instead it is necessary to formulate normed calculations for standard sizes ("representatives") in individual profiles, for each of the price list steel groups from which they are manufactured. In this connection use might be made of the method described in the section on the prices of semifinished rolled products.

After the prime costs and prices of the so-called "representatives" are calculated, the prices of the other sizes may be correspondingly related, assuming that:

(1) the charge costs for diverse sizes of a given profile in a given group of steels stand at the same level (in zlotys per ton) as the costs of the "representative" of that group, provided that the yield be expressed by the same percentage; at a change in yield the charge costs should be commensurately revised;

(2) the processing costs of individual sizes of a given profile in a given group of steels evolve, in relation to the processing costs of the "representative" of that group, in direct proportion to the indexes of labor-consuming capacity.

Hence in this case use may be made of the R_2 indexes whose method of calculation has been cited previously.

In this way it will be possible to avoid the irregularities ensuing from the excessive number of estimates entailed in the method adopted for determining prices for 1956.

It appears that the paramount error made during the determining of the 1956 prices of rolled products (and also the error

from which the other, smaller errors ensued) was the attempt to base the prices of individual type-sizes on the mean weighted prices of calculation groups in spite of the total ignorance of the assortment structure within these groups. In this connection it was overlooked that any errors in estimates (not always avoidable) that result in errors in the relationships determined among the prices of individual products cause the verisimilitude of the mean weighted prices per calculation group to be very doubtful. Hence there may even arise another danger consisting in that, contrary to the postulates adopted, the total value of the output of rolling mills as calculated in sales prices may differ considerably from the sum total of the prime costs of that output. Therefore, as it appears, in the future the determination of prices should be based on the normed costs of individual type-sizes and not on the mean weighted prime costs of calculation groups.

As noted before the relating of prices to the theoretical weight of product is another important problem, and this pertains not only to metallurgy but also to other branches of industry, such as the papermaking industry.

The 1956 price list introduced for the first time the principle of the breakdown -- with respect to certain products of cogging mills -- of the deliveries from purveyor to receiver on the basis of the actually delivered linear meters of these products as calculated in terms of the price-listed theoretical weights. Such products include, among others:

(a) C-sections 200 to 300 mm high;

(b) I-sections 200 to 550 mm high;

(c) angle sections with arms 150 and more mm wide;

(d) rail sections for portal conveyors;

(e) railroad rail sections 115 and more mm high;

(f) tramway rail sections.

Prior to this, when, for instance, a purchaser needed 10 km of narrow-groove (160 W) tramway rails and ordered 525 t (as per catalogue), he actually received 525 t of rails but their length totaled only 9.6 km. This was because the steel plant found it more profitable to roll the rails at an upward thickness clearance, because this was less labor consuming, while the purchasing plant had to pay for the actual weight of the goods delivered.

Or if a purchasing plant plans to lay, for instance, 5 km of tramway track, although it has exhausted the funds assigned to it in the investment plan project for the purchase of rails, it will be able to use the received rails to lay a track 200 m shorter than planned. Therefore the material plan of the related investments could not be fulfilled, because the purchasing plant exhausted concurrently the rail tonnage assigned to it.

Such practices on the part of the steel plants not only exerted an adverse influence on the fulfillment of the investment plan but also contributed to the wasting of steel in the national economy.

Let us assume that the clearance for a linear meter of rail amounts to ±3%. If the plus clearance be abandoned in favor of the minus one, 6% of steel could be saved. This would mean that the quantity of steel assigned for manufacturing 100,000 t of rails

would suffice for rolling an additional quantity of rails sufficing for laying an additional 60 km of track.

The new principle adopted in the 1956 price list will undoubtedly influence a reduction in the weight of the rolled rails and sections down to the limits of the "minus" clearance (permitted by the standards). Otherwise if in 1956 a steel plant delivers to the purchasing plant 525 t of 160 W rail, having an over-all length of 9.6 km instead of 10 km, it will be paid for only 504 t, and thus it will sustain a loss. Furthermore only 504 t will be credited to its fulfillment of the value of output, and this will affect the bonuses received by the steel plant management for implementing the plan of output by value.

There is not any doubt that the principle of computing the value of rails and sections according to their theoretical weight will be an important economic incentive for a more efficacious utilization of steel in national economy.

It needs only to be considered whether this principle could not also be gradually applied to the other rolled products.

There exists a price list in which the principle of computing the value of production according to theoretical weight has already been applied to all products concerned. This is the price list of steel structures. However in this case the problem was not to save metal (the combined total weight of the Polish-produced structures is much more lower than the corresponding weight of the Polish-produced rails and sections) but to safeguard the nonsurpassing of the planned (in estimates) quotas of funds assigned for the purchase of steel structures. However a close observance of

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this principle might lead to adverse economic consequences. For instance the producers who do not have in stock steel sections of sufficient thinness would have to postpone manufacture of steel structures until such time when the steel plants deliver to them the necessary type-sizes. Hence an arbitrary solution was decided upon. Producers of steel structures may invoice them according to actual weight, provided it does not exceed 3% of the theoretical weight of structures. Whenever actual weight exceeds by 3%, the delivery is invoiced according to theoretical weight increased by 3%. To avoid having to make any subsequent corrections, the value of the structures is planned in the estimates according to theoretical weight increased by a 3% allowance.

However this solution is not adequate in every case. The producer may continue to avoid manufacturing structures from sections or sheets with dimensions that might cause the structures to surpass the theoretical weight by more than 3%. Therefore the price list contains an additional clause permitting the producer, in exceptional and especially well-founded cases, to sign a contract with the purchaser -- subject to approval by the minister to whom the purchaser is subordinate -- for delivering and invoicing steel structures according to actual weight even when it is more than 3% higher than theoretical weight.

Aside from the previously mentioned surcharges for metallurgical certification and technical reception, the price lists of rolled products also include surcharges for "unsuitability," accurate rolling, specified length, standardization, softening, and delivery in quantities below the minimum prescribed norm.

The introduction of surcharges for "unsuitability" purports to reduce and eventually to eliminate the demand for products of this sort. This is because a reduction in the scope of the rolled profiles and sizes is one of the most effective ways of raising labor productivity in rolling mills. Hence any profiles and sizes not mentioned in the prescribed programs of rolling and catalogues are regarded as "unsuitable" products. The surcharge for "unsuitability" is thus of an explicitly prohibitive nature. It is thereby expected that the purchasers, desirous of reducing their prime costs, would attempt to modify the designs of their products so as to avoid having to place orders for "unsuitable" raw material products.

A prohibitive trait can be also discerned in the surcharge for the delivery of quantities smaller than the minimum prescribed ones. The purpose of this surcharge is to protect the steel plants from receiving an excessive number of petty orders that would disorganize its production. Clients for small quantities of products should acquire them from the stores of the Sales Bureaus of the Central Board for Steel Marketing, and not from steel plants. These stores, by accumulating orders placed by a number of purchasers, are able to order the products from the steel plants in quantities great enough to make the surcharge inapplicable. In this case every purchaser who places orders with the said stores pays the regular price plus only 3% as the store profit margin whereas if below-minimum quantities are ordered directly from a steel plant, the purchaser has to pay the following surcharges:

up to 50% of the norm	10%
less than 50 and up to 25% of the norm	20%
less than 25% of the norm	50%

It is only in the exceptional cases when a store cannot accumulate a sufficient number of orders that the purchaser is surcharged for the small quantity. However such cases occur only whenever it is a matter of a particularly "unsuitable" or special profile or size or when it is necessary to make an exceptional delivery.

The other surcharges (for specified length, accurate rolling, standardization, and softening) make it possible for the steel plants to defray the costs caused by the additional requirements posed by the purchasing plants. Nonetheless they also are of a prohibitive nature, especially the surcharges for specified length.

By demanding products of a specified length the purchaser can be sure of reducing its own material costs because then the quantity of wastes is smaller. This can be easily illustrated by the following example.

Plant X employs in its production process, aside from other rolled sections, flat rods with a thickness of 6 mm, width of 50 mm, and length of 4 m, in a quantity totaling 800 t annually. If an order placed by Plant X does not mention a specifed length but merely mentions rods with limited dimensions (4 to 6 m) no surcharge will be required. However Plant X would then have a great number of wastes (flat rod trimmings up to 2 m by length, which may total, for instance, 200 and more tons).

If specified lengths are ordered -- with a tolerance of up to 75 mm -- the amount of wastes will decline considerably and Plant X will reduce its material costs.

On the scale of the machine building industry as a whole, such savings could be expressed in tens of millions of zlotys.

On the other hand, although it is to be expected that steel plants meet with definite difficulties when cutting rolled sections into specific dimensions, they must take into account the shrinkage of metal at various temperatures, and they must make sure of the proper profile dimensions and length of the blooms used as charge in rolling mills, etc. All this not only causes additional costs to steel plants but also restricts the productive capacity of their rolling mills, which, in principle, would be much more harmful to national economy than the appearance of an additional amount of wastes in the processing industries. This is because these wastes may be utilized in secondary production in situ or in the other plants of the major or minor industry, whereas if the productive capacity of rolling mills is reduced, national economy will receive a smaller amount of rolled products, and this will among others also curtail the possibilities for an increase in the output of the machine building industry.

Surcharges for specified length, which in certain cases amount to as much as 20 and more percent of the regular price of a given rolled section, discourage the purchasers from a too impetuous and unpremeditated placing of orders.

Surcharges for accurate rolling apply whenever a purchaser demands that certain rolled products be manufactured at smaller clearances of the dimensions of profile or thickness than provided by the prescribed standards. These clearances are foreseen chiefly because when a rolled product is cooling it also shrinks, and the exact extent of that shrinkage is difficult to estimate, because it

hinges on the temperature of the metal at the moment when it passes through the rollers (a temperature that, as is known, fluctuates). Besides the extent of clearances is also affected by the extent of the depreciation of rollers and their attachments.

The prescribed standards provide for specific clearance limits for rolled products as justified by objective considerations. On the other hand, if a steel plant has to execute rolled products with clearances smaller than prescribed by the standards, it is posed by a very difficult task and hence it sustains additional losses.

4. Other Rolled Products

General characteristics of slabbing-mill products. Determining the prices of slabbing-mill products. Relationships among prices of products rolled from diverse materials.

This section uses the prices of the products of slabbing mills as the example of the previously unmentioned problem of relationships among the prices of similar products made from different raw materials. This section will also describe the most characteristic errors committed during price determination and the consequences of these errors.

In addition to cogging mills, slabbing mills also account for a considerable share in the plastic processing of steel. Mills of this type serve to manufacture slabs, plates, thick, thin, and standard sheets, and cold-rolled strips.

The thickness of these products is variegated. For slabs the thickness ranges from 60 to 200 mm, for standard sheets from

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5 to 40 mm, for thick sheets from 5 to 60 mm, for thin sheets from 0.24 to 4.5 mm, and for cold-rolled strips from 0.10 to 4.0 mm.

The divergences in the widths of these products also are considerable.

The data pertaining to the multiplicity of the products of slabbing mills reveal clearly the great difficulties involved in determining the prices of these products.

Various methods have been adopted for determining the 1956 prices of individual products of slabbing mills.

The prices of slabs and sheets were determined according to principles analogous to those applied to square blooms and other semifinished rolled products described in the preceding section.

In the case of sheets a noteworthy fact is that every price-list item comprises a considerable number of catalogue sizes (thicknesses and widths). For instance the first-ranking item in the price list of universal sheets (2,206 zlotys a ton) comprises 48 catalogue type-sizes made from 3 grades of steel representing 2 price-list groups of steels. Such an approach evokes reservations.

It is certain that the manufacturing costs of such a great number of catalogue type-sizes will deviate considerably from each other. If a uniform price be fixed for all these type-sizes the differences in the profitability of the production of specific type-sizes will impel the steel plants to concentrate their production chiefly on the more profitable type-sizes of sheets. This may result in a situation in which the purchasing plants will be

compelled either to wait months for sheets of a specific thickness or to accept whatever sheets are offered to them by the steel plants (provided of course that they are suitable). As a result a steel structure which was to weigh 200 t according to theoretical weight, would actually weigh 205 and more tons. This of course leads to squandering of steel.

As is known, some steel plants have stocks of certain types of sheets which cannot find purchasers, whereas other types are in a very great demand. It is also known that purchasers may obtain certain type-sizes of sheets with greater ease than others even if all these type-sizes were comprised together in a single price list item. Among the various reasons for this phenomenon the undoubtedly major one is that the uniform price of type-sizes having varying prime costs is not favorable to the fulfillment of plans of the range and variety and output nor to a proper supplying of purchasers with the products they need.

The prices of individual sizes of sheets were differentiated depending on the grade of steel from which they were rolled. The subgrouping of steel grades in the price list of sheets does not, however, correspond to their subgrouping in the price list of cast steel. Owing to this discrepancy between the 2 price lists of ferrometallurgical products there occur such irregularities as, for instance, the fact that the price of a 10-mm sheet, whether made from the "x" or the "St 0 S" steel grade, is the same, namely, 2,233 zlotys a ton, whereas the price of Grade "x" cast steel ingots amounts to 1,350 zlotys a ton, and the price of Grade "St 0 S" cast steel ingots is 1,430 zlotys a ton.

A similar difference occurs also between prices of plate (a semifinished product made from both grades of steel), although plate constitutes charge material for thick-sheet rolling mills.

All these discrepancies, and many more, ensue chiefly from the circumstance that the problem of interrelating the sheet prices has not been properly solved. This is because the determination of sheet prices was based on the mean weighted production costs of assortment groups, while the relationships among prices within individual price-list items were worked out on the basis of insufficiently reanalyzed empirical indexes (pertaining to the yields and labor-consumption of the production of individual type-sizes of sheets), or were merely estimated. In the future the prices of rolled sheets should be determined differently.

First of all it is necessary -- it appears -- to increase the number of items in the sheet price list. No single item should comprise such a great number of type-sizes as at present. At such an approach it may be succeeded in approximating the prices of individual type-sizes to their prime costs. In this connection use might be made of the same method (see page 110) as the one applied for the products of cogging mills (in spite of some difference between the technologies of production in both types of mills).

A similar method might be also applied when determining the prices of cold-rolled strips.

The 1956 prices of cold-rolled strips have been determined by the same method as the prices of the products of cogging mills. Therefore it is unnecessary to describe here the mistakes involved in determining these prices as they have already been described in

the preceding section. However it is to be emphasized that in spite of these mistakes, the prices of cold-rolled strips have been determined much more correctly than the prices of rolled sheets, because the method applied for determining the prices of cold-rolled strips and cogging-mill products certainly constitutes considerable progress compared with the previously used methods. However the same cannot be said of the method used in pricing rolled sheets and, besides, that method cannot be perfected and should in general be abandoned.

The determining of sheet prices should entail an examination of the correctness of the relationships among the prices of sheets made from differing kinds of raw material. For instance a zinc sheet of a definite thickness should not cost less than a galvanized sheet of same thickness. White (galvanized-tin) sheet should not be cheaper than a galvanized-zinc sheet of same thickness. Unfortunately a mistake of just this sort was made in the 1956 price list where galvanized-tin sheets 0.50 mm thick, of C Steel Grade, are priced at a lower level than galvanized-zinc flat sheets of same thickness. Such an error had to arise owing to mechanical application of the principle of making the price equal to prime cost. If galvanized-tin sheets are manufactured in the more modern plant assemblies than galvanized-zinc sheets are, then even if the price of tin is much higher than the price of zinc, it may be found that the prime costs of the galvanized-zinc sheets of same thickness are higher. The method applied in determining sheet prices may give rise to relationships among the prices of various products that do not concur with the utile value of these products and are unjustified from the economic viewpoint considered.

It becomes thus clear that the mere proper interrelating of the prices of raw materials is not in itself sufficient for insuring a proper relationship among the prices of the products made from these materials. Furthermore it is to be noted that the degree of labor consumption required by individual products should be properly expressed. If, for instance, 2 types of products may be manufactured in identical plant assemblies within a single production enterprise but for various reasons are actually manufactured in different enterprises with differing prime costs of production, the normed prime cost of the standard plant should be adopted as the basis for determining the prices of both kinds of products. In this connection the normed labor costs and departmental costs should be calculated in the same way as when both these types of products are manufactured in the same plant assembly.

The application of this principle for determining sheet prices creates the conditions for avoiding the above described errors, and moreover then the interrelationship of the prices of the materials used for manufacturing these sheets will be fully expressed in the level of the prices of the finished products.

5. Steel Pipes

General characteristics of pipe grades. Methods for determining pipe prices.

The prices of steel pipes differ from the prices of other metallurgical products in that they pertain not to weight of product but to its length as expressed in meters at the proper wall thickness and pipe diameter. The pipe price list also specifies

the theoretical weight of individual pipe grades used as the basis on which to calculate pipe length for invoicing purposes.

Pipe prices constitute the simplest and -- it appears -- most glaring example of the adverse effects of determining prices on the basis of the mean weighted prime cost of an entire group of products.

Steel pipes are divided into 2 principal kinds: seamless pipes and welded pipes.

The 2 kinds differ from each other chiefly in the methods by which they are manufactured. Seamless pipes are manufactured in tubing mills by means of hot or cold drawing. Welded pipes are manufactured by means of heating together or welding properly prepared strips of sheets.

In addition the following types of pipes are distinguished: light (gas) and heavy (steam), threaded and smooth, flared and flanged, long-distance and precision conducting, boiler pipes, drilling pipes, well pipes, etc.

The pipe price list has, like refractory materials price list, a practical purpose. Instead of specifying the grades of steel from which the individual types of piping are made, it indicates the purpose for which a given pipe type is applicable. This is doubtless a great aid to the purchaser. Moreover the steel pipe catalogue is arranged in the same way, and there is practically hardly any difference between the nomenclature used in the price list and that used in the catalogue.

The method of determining pipe prices adopted for 1956 is distinguished by its tremendous simplicity. It ensues from the following postulates.

(1) Every kind and type of steel pipe is represented in diverse diameters, and each of these diameters may pertain to a different wall thickness; hence the price of a ton of pipe having a given diameter should be uniform regardless of wall thickness.

(2) The height of pipe prices should correspond to their planned prime costs.

(3) Uniform prime costs -- to be used as the basis for determining pipe prices -- should be calculated for all the diameters of a given kind and type of pipe.

(4) Pipe prices should be calculated in relation to a linear meter of the given kind and type of pipe having a specific diameter and wall thickness; in this conjunction, these prices are to equal the mathematical product of the price of one kg of the pipe multiplied by the weight of the linear meter (as expressed in kg) proper for the given wall thickness.

Let us assume for instance that the uniform prime cost of an electrically welded steel pipe with an outside diameter of 26 mm amounts to 5,000 zlotys a ton, and hence the cost of one kg of that pipe equals 5 zlotys.

According to the above mentioned principles, the price of one kg of that pipe should equal 5 zlotys and the price of one linear meter of that pipe, which has a wall thickness of 2.6 mm, should equal 7.50 zlotys, considering that 5 zlotys/kg x 1,500 kg/m = 7.50 zlotys/m, the 1,500 kg/m being the weight of such pipe with a wall thickness of 2.6 mm.

As mentioned before the unusual simplicity of this method would seem to be its great merit, especially as the determination of planned prime costs does not either involve any difficulties because calculation groups pertain just to individual diameters of the appropriate kinds and types of pipe.

Actually, however, this method entails such far-reaching oversimplifications that it wholly distorts the correctness of price relationship among individual price list items.

This is because if, for example, the prime cost of a ton of an electrically welded pipe with an outside diameter of 26 mm is uniform regardless of wall thickness (0.8 to 2.6 mm), an obvious error is thereby committed. After all electrically welded pipes are made of sheet metal, and the prices of sheet metal differ depending on its thickness. For instance a 0.8-mm sheet made from Grade B 60 steel costs 3,618 zlotys a ton, while a 2.6-mm sheet made from the same steel costs 3,298 zltoys a ton. Besides the length of a ton of the pipe with a wall thickness of 0.8 mm would be 3 times as great as the length of a ton of same pipe with a wall thickness of 2.6 mm. Therefore, in the former case, the cost of electrical welding will be 3 times as high as in the latter.

The prime costs of pipes (as related to their diameters only) are hence mean weighted costs and their height depends largely on the ratio of pipes with thinner walls to pipes with thicker walls in the total output of pipes of a given diameter.

If the prices of welded pipes be determined on the basis of these costs it may be found that a steel plant sustains losses when manufacturing pipes with thinner walls, whereas it will draw high

profits from manufacturing pipes with thicker walls. Such a pricing arrangement would obscure the actual picture of the achievements of the plant and it might affect adversely the fulfillment of the plans of range and variety of output. Desiring to avoid losses, the steel plant would avoid manufacturing thinner-walled pipes, and the purchasing plants would meet with great difficulties in obtaining such pipes.

It is also to be emphasized that the planned mean weighted prime cost of a calculation group cannot serve as the basis for determining the sales price. Therefore it is necessary to determine the normed prime cost of the production of individual assortments comprised within a given marketable output group.

The above described problem pertains to all pipes, including seamless ones, although in the case of the latter the errors of the current method are not as glaring as in the case of welded pipes.

6. Ferroalloys

General characteristics of ferroalloys. Determining the prices of ferroalloys and their interrelationship. Prices of ferroalloys versus prices of refined steels.

In certain cases specific commodities are interchangeable and the relationship between their utile values is easy to establish. Hence it would seem that all conditions are provided for determining the prices of such products according to the principles of equivalent relationship. However sometimes economic considerations make it necessary to use the principles of direct relationship when determining the prices of such interchangeable products.

This takes place when determining the prices of, among others, ferroalloys.

The term "ferroalloys" is generally applied to those alloys of iron with other metallic and nonmetallic elements in which these elements are more greatly represented in percentage than in diverse kinds of steels. Considering that ferroalloys are used nearly exclusively as alloy admixtures to charges in steel plants in order to insure the desired chemical composition of steel or to remove harmful admixtures, the group of ferroalloys includes also certain other alloys of metals with nonmetals used for similar purposes.

The principal types of ferroalloys include: ferromanganese (Fe -- Mn), ferromolybdenum (Fe -- Mo), ferrotungsten (Fe -- W), ferrotitanium (Fe -- Ti), ferrochromium (Fe -- Cr), ferrozirconium (Fe -- Zr), ferrovanadium (Fe -- V), ferronickel (Fe -- Ni), ferrosilicon (Fe -- Si), ferrophosphorus (Fe -- P), and silicon-manganese, silicon-calcium, etc.

Some of these ferroalloys are manufactured in Poland from domestic raw materials, others from imported raw materials, and the remainder exclusively from imports.

Under these conditions the selection of a proper method for determining the prices of ferroalloys is quite a difficult task. It appears no single method can be used for determining the prices of all types of ferroalloys.

The prices of ferroalloys manufactured from domestic raw materials, such as ferrosilicon or silicon-calcium, should in principle be based on prime costs; in this connection, the interrelating of the prices of ferrosilicons with varying contents of silicon

or silicon-calcium with varying contents of calcium and silicon, should be based on the previously described direct relationship. In this way, for instance, the price of ferrosilicon with a higher content of silicon will be higher because the related prime cost is also higher (we refer here, of course, to the production costs of the standard plant). The use of the mean weighted prime cost of the ferrosilicon might backfire here in view of the differences in the technological equipment of individual plants.

The same pertains to calcium-silicon, where the prime cost of production is lower at a lower content of calcium and vice versa.

Is it correct to determine the prices of these ferroalloys on the basis of the principle of direct relationship, that is, in a directly proportional ratio to their prime costs? It may be objected that the utile value of ferrosilicon alloy with a content of, e.g., 75% of Si does not evolve in the same relation to the utile value of a ferrosilicon alloy with 85% of Si as do the prime costs of both these ferroalloys.

In this connection the prime cost of the production of a given grade of steel depends also on the type of the ferrosilicon alloys (and its content of Si) used as alloy admixture to charge. In the former case, a somewhat greater (by about 10%) amount of ferrosilicon has to be used, but its price will still amount to less than 1/2 of the price of the ferrosilicon with an 85% content of Si.

This appears right and proper. Ferrosilicon alloys with differing contents of Si are mutually replaceable. From the viewpoint of the interests of the national economy, steel plants should

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therefore use the ferrosilicon alloys whose production and utilization are cheaper. Let us illustrate this by an example.

Let us assume that the prices of ferrosilicon alloys with 75% and 85% contents of Si are about equal to their prime costs of production. The production of a specific quantity of molten steel requires that cast steel be admixed with 170 t of the silicon contained in the ferrosilicon alloys for technological reasons. In order to furnish the steel with that amount of silicon it is necessary to consume either 200 t of a ferrosilicon alloy with an 85% content of silicon or about 227 t of the alloy with a 75% content of the same. The manufacture of these quantities of ferroalloys will cost national economy:

(a) in the former case: 200 t x 9,445 zlotys a ton = 1,889,000 zlotys;

(b) in the latter case: 227 t x 4,000 zlotys a ton = 908,000 zlotys.

If the price of these ferroalloys corresponds to their prime costs, the purchasers, being desirous of reducing their own prime costs of production, will try to use more of the alloy with a 75% content of Si because this will be more profitable to them. It is also simultaneously profitable to national economy.

It appears that this problem has much greater implications and that the above cited solution may also be applied toward other kinds of mutually replaceable supply goods manufactured from domestic raw materials.

However here a very vital circumstance should be mentioned; namely, does the purchasing plant when placing its orders have full freedom in selecting materials? If this is not the case and the purchaser is compelled to take only the products that are offered to him, the adoption of the principles of direct relationship for determining the prices of replaceable materials would not yield positive advantages to national economy and might even cause it to sustain considerable losses because then the producer would offer a quite accidental range of output without considering production costs as the height of the price would assure him in every case of the profitability of producing these goods. The purchaser, on the other hand, having no choice but to accept the materials offered to him, would sustain fluctuations in his prime costs and profitability of production -- depending on the kind of delivery he receives. It is clear that such a situation would contribute to a senseless squandering of means of production in national economy.

Hence it appears that so far as replaceable materials are concerned, when the purchaser lacks complete freedom of choice, the price of the material should be determined according to the principles of equivalent relationship. Thereupon the purchaser will not sustain avoidable losses and the purveyor will become interested in manufacturing products whose prime costs are minimal and utile values maximal.

To illustrate this thesis, let us proceed on the following abstract assumption.

A producer manufactures only 3 kinds of ferrosilicon alloy -- A, B, and C. In this connection, the purchaser must accept the kind offered to him because he will not receive any other.

The prime cost of ferrosilicon alloy A is 3,000 zlotys per ton.

The prime cost of ferrosilicon alloy B is 4,000 zlotys per ton.

The prime cost of ferrosilicon alloy C is 10,000 zlotys per ton. The ratio of the utile values of these alloys is as follows: A:B:C = 1:1.5:2.

If the prices of these ferroalloys be determined on the basis of direct relationship, at a S_p (direct relationship index) equal to 1.0, these prices will be:

Alloy A -- 3,000 zlotys per ton

Alloy B -- 4,000 zlotys per ton

Alloy C -- 10,000 zlotys per ton

On the other hand, if these prices be determined on the basis of equivalent relationship, when S_e (equivalent relationship index) equals 1.0, and with the price of Alloy B adopted as the basis for the relationship (P_c value), the interrelationship will be different. If the price of Alloy B be fixed at 4,000 zlotys a ton, the price of Alloy A will be 2,666 zlotys a ton and that of Alloy C -- 5,333 zlotys a ton.

While in the former case (prices determined on the basis of direct relationship) the producer has no interest in manufacturing a specific ferrosilicon alloy, in the latter case (prices determined on the basis of equivalent relationship), he will concentrate chiefly (if not solely) on manufacturing Alloy B because its utile value is the highest and the ratio of its cost to its price is the most favorable.

As can be concluded from the above, the selection of the form of relationship on the basis of which the prices of mutually replaceable materials are to be determined must be preceded by deciding who should have a greater influence on defining the range and variety of output -- the producer or the purchaser.

If a producer must absolutely execute the orders placed with him by purchasers and draft his output plan in consonance with their demands, the principles of direct relationship must be applied when determining prices. In this way the purchasers will be inclined to place orders for the lowest priced materials (whose prime costs are lowest also) with the highest utile value. If however the purchaser has but a very limited influence on the range and variety of the producer's output, the sole correct solution is to apply the principles of equivalent relationship for determining the prices of mutually replaceable materials.

Hence the justice of the one or the other method applied for determining the prices of ferroalloys produced from domestic raw materials depends on the justice of the decision that the orders placed by the purchasers exert the principal influence on the range and variety of the output of these alloys.

The prices of the ferroalloys deriving from imported raw materials may also be determined at a level corresponding to their prime costs. This is unnecessary only whenever a given ferroalloy produced from imported raw materials may be replaced by a ferroalloy produced from domestic raw materials. In this case the ratio of the price of the former to that of the latter should not be smaller than the ratio of the utile values of both alloys, even if the ratio of their unit prime costs is different. If, on the other

hand, the ratio of the unit prime costs of both ferroalloys (of the former to the latter) is expressed by a higher number than the ratio of their utile values, the prime costs of both alloys should be used as the basis for determining their prices.

The third group comprises ferroalloys that are not produced in Poland (are imported) and the ferroalloys produced in Poland from the imported raw materials the prices of which should be based on their relation to the prices of the ferroalloys; for instance the ferrotitanium produced from rutile or ilmenite. In Poland these 2 minerals are generally used solely for producing that ferroalloy.

Accordingly the principle adopted -- and apparently correct -- was that the prices of these minerals should be determined according to the following formula:

$$P_x = \frac{P_z - K_p}{N}$$

where: P_x = price of imported mineral in zlotys per ton (that is, price of raw material necessary for producing a given ferroalloy);

P_z = price of ferroalloy in zlotys per ton;

K_p = processing cost per ton of ferroalloy;

N = quantity of tons of mineral consumed for producing a ton of the given ferroalloy.

However there arises the question of how to determine the price of the given ferroalloy itself, or of other imported ferroalloys. This problem is quite difficult because the absence of sufficient experience prevents a comparison of the utile value of these ferroalloys in relation to the ferroalloys whose prices are based on prime costs. Hence there is an absence of the factors necessary for applying the equivalent relationship methods.

The determination of the 1956 prices of these products was based on the prices official in the Soviet Union. This was because it was considered that Soviet steelmen possess considerable experience in this field and that the relationships among the prices of ferroalloys in the Soviet Union are doubtless economically justified.

However it is to be emphasized that the acceptance of the price interrelationship based on the above motives should be regarded as a necessary evil. This is because benefiting from the experiences of other countries should in no case signify a "blind" emulation.

The correctness of the level of ferroalloy prices is of great importance for determining the correct level of the prices of alloy steels because the prices of the former are generally based on prime costs and the value of the expended alloy components affects considerably the prime costs of alloy steels.

It may be thus stated that the decisions concerning the price levels of ferroalloys affect substantially the relationships among the prices of diverse kinds of refined steels.

7. Refined Steels

General characteristics of quality steels. The surcharge and discount system. Prices of refined steels versus prices of nonferrous metals. Prices of refined steels versus prices of plastics.

The preceding sections described methods of simplifying price lists with respect to products manufactured in a wide range and

variety of forms. The determination of the prices of rolled products rolled from ordinary carbon steel was based on individual type-sizes (sizes of specific types) as the fundamental units of relationship. The classification of products according to the grades of steels from which they were manufactured fulfilled there merely an auxiliary role. This was because the important thing was to make the prices incentives for a maximal utilization of the productive capacities of rolling mills. On the other hand the problem is quite different with respect to products from refined steels, which are manufactured in a still wider range and variety of forms than is the case with products rolled from ordinary carbon steel. Considering that refined steels usually contain very valuable and scarce alloy admixtures, the prices of refined-steel products should act as incentives for purchasers to save the most scarce steel grades, namely, grades with the highest content of such components as chromium, nickel, molybdenum, tungsten, vanadium, cobalt, etc. This goal is materialized by, among others, the specific structure of the price list of refined steel products, as described in this section.

This section will also touch upon the problem of the necessity of preserving the proper relationship among the prices of large groups of products manufactured from different raw materials when such products find identical or similar applications. This pertains, for example, to relationship among the prices of certain (corrosion-resistant) grades of refined steels, and of ferrous metals (copper, brass) and plastics (faolite, textolite, vinidur, etc).

Refined (quality) steels include various kinds of steels belonging to the following 4 classes: 2, 3, 4, and 5 (Class 1 includes ordinary carbon steels).

Class 2 comprises structural steels;

Class 3 comprises tool steels;

Class 4 comprises special steels;

Class 5 comprises nonstandard steels.

Class 2 comprises chiefly 2 kinds of steels: alloy and nonalloy steels. In Class 3 the 3 principal kinds are nonalloy, low-alloy and high-alloy steels; and Class 4 contains only alloy steels. The official roster of quality steels numbers about 400 steel grades, and each of these grades may be used for manufacturing rolled, drawn, and forged metallurgical products of various shapes and dimensions. Hence the price list of these products cannot be drawn up in the same way as the price list of products from Class 1 steel because this would require several years of labors by an entire "staff" of experts, and the price list itself would then consist of several score volumes.

Individual grades of refined steels cannot be combined into groups unlike ordinary steels. The substantial differences existing among individual grades of refined steels cause the necessity of determining a specific sales price for each of these grades. With respect to refined steel the problem of the accurate determination of the price of material from which a product is manufactured is of much greater importance than the problem of determining the labor-consumption capacity of individual products.

Proceeding on this assumption the price list of refined steel products has been drawn up in a totally different way than the price lists of ordinary steel products. The price of each and every grade of refined steel has been determined separately for rods of standard profile and thickness. The prices of other assortments were determined through the surcharge and rebate system. The surcharge and discount rates as expressed in percent of the price of the standard type-size or in zlotys per kilogram (this more rarely) are to cover the difference between the processing costs of the given type-size and the processing costs of the standard type-size.

Let us take for instance the ingots rolled from low-alloy tool steel. Their price is thus determined: the price of the standard type-size as specified in the price list for the given grade of steel is decreased by a 30% discount. On the other hand, for instance, the price of a strip cold-rolled from low-alloy tool steel, 15 to 60 mm wide and 0.10 to 0.16 mm thick, is calculated by adding a 160% surcharge to the price of the standard type-size produced from that grade of steel.

It is also necessary to explain the method used for determining the 1956 prices of standard type-sizes produced from individual grades of refined steel, and the foundations on which the rates of the surcharge and discount tables have been based.

The prices of standard type-sizes were calculated on the basis of the planned or resultant prime costs of the production of related grades of steels. Next certain corrections were carried out in cases when, owing to diverse transitory reasons, the calculations indicated excessively high prime costs of the production

of steels that are less valuable from the viewpoint of the content of alloy components, as compared with the prime costs of the more valuable steels. On the other hand the norming of the prime costs of the production of individual steel grades was ignored. The thus adopted method of price determination is justified, true enough, by the fact that the complicated technological process of the production of refined steels and the absence of technological norms aggravate the computing of normed costs. Nonetheless, even in actual conditions, this method cannot be regarded as correct. This is because the height of the resultant or even planned prime costs of refined steels is affected considerably (especially owing to the incomplete mastering of the technology of production of certain grades) by factors of an accidental nature. The adopted method of price determination will doubtless lead to considerable variations in the profitability of steel plants in measure with the eventual progress in mastering the technology of production of individual grades of steels, in the event that the range and variety of output be altered because the ratio of prime cost to price will differ for each grade of steel. This may exert an undesirable and adverse influence on the readiness of steel plants to undertake the production of some grades of refined steels. Hence it appears that the prices of individual steel grades should be also based on norming calculations, even if only on the basis of provisionally computed technological norms of material consumption and of human and mechanical labor productivity. This goal is difficult but is doubtless wholly realistic.

The height of surcharges and discounts should be -- it appears -- so computed as to assure the profitability of the production of the cheapest grades of the products rolled or forged from

a given group of steels. This pertains to the usually popular steels which may be acquired without special difficulties. True enough this principle means that a steel plant will obtain additional profits when manufacturing a given product out of the most expensive grades of steels, but it appears that this will not lead to wasting the most valuable grades of steels because:

(1) the purchasing plant will be interested in acquiring the products at the lowest price, and therefore it will avoid, insofar as possible, placing orders for products made from the more expensive grades of steels;

(2) there is an entire system of restrictions concerning the consumption of the most valuable grades of steel.

Let us illustrate this by the following example.

In relation to the price of the standard product (the standard or basic product adopted in the price list of refined steels is a rolled rod with a thickness of 100 to 160 mm and a square or rounded profile), the surcharge for a rounded or square polished rod drawn from structural alloy steel with or without nickel and having a cross-section (profile) of 1.5 to 2 mm amounts to 300%. The prices of standard or basic products made from these groups of steels range (depending on steel grade) from 3.15 to 12.60 zlotys per kg. Let us further assume that the steel plant manufactures rounded, drawn, and polished 2-mm thick rods from 120-mm thick rounded rolled rods. Hence the 300% surcharge added to the standard price is intended to cover the processing costs and material losses sustained by the steel plant owing to additional wastes. If the steel plant manufactures rods from Grade PS1 steel, the

surcharge will be 9.45 zlotys per kg and if from Grade 25HNWA steel, it will be 37.80 zlotys per kg. And yet the difference between the production costs of rods from the 2 grades of steel is certainly not as great, even if it be considered that the material losses caused by wastes are expressed in a higher sum in zlotys per kg than is the case with the less expensive steel. Accordingly the steel plant will find it more profitable to produce 25HNWA steel than PS1 steel.

There now arises the question whether, as a result, the steel plant will offer to purchasers products from Grade 25HNWA steel instead of from Grade PS1 steel? Decidedly not. Aside from the fact that each of these 2 grades serves for different purposes, in principle, and that the former grade costs the purchaser 4 times as much as the latter, there arises still another, important circumstance: Steel PS1 belongs to Category A and may be used without any restrictions for the normal fulfillment of production and supply plans, whereas Steel 25HNWA belongs to Category C and may be used only subject to prior approval by the chairman of the State Economic Planning Commission.

It appears that the problem of the proper determination of the profitability of production of goods from the cheaper steel grades should be considered more seriously than the problem of avoiding excessive accumulation at the production of the more expensive steel grades. This is a question of averting a situation in which the output of individual types of products would involve differing accumulation (or losses) depending on profile or size and not on grade of steel. Doubtless such a situation would affect adversely the punctuality of execution of orders, and it would

incline the steel plants to offer thicker, instead of thinner, profiles to purchasers, and so forth.

The method by which surcharges and discounts were determined for 1956 does not fully insure the avoiding of differences in the level of accumulation at the production of individual type-sizes from the cheaper grades of steel. Figures from resultant calculations have been here considered only a little; approximate estimates were chiefly used as the basis. It is to be assumed that the surcharges take into account normed processing costs, although reservations may be evoked as to the method and pertinency of calculations. Basically the reservations do not pertain to some errors in the level of surcharges as caused by the primitiveness of the estimates; rather the greatest shortcoming of the method adopted is the absence of any consistent guiding outline to be followed when determining these surcharges. This was because of the attempts made to determine, for whole groups of steels, some mean difference between the production costs of a specific type-size and the production costs of the standard type-size and that moreover in the form of a percentile ratio to the varying (depending on grade of steel) price of the latter. On the other hand no attention was devoted to the problem of differences in the profitability of the manufacture of individual products from different grades of steel comprised in one and the same group. Thus it is not inconceivable that the profitability of the steel plants manufacturing refined-steel products and the action of prices will in practice differ somewhat from the postulates adopted when determining the 1956 prices.

On reviewing the prices of refined steels we encounter not only with the problem of the ratio of prices to prime costs of

production but also with the problem of a correct determination of the relationship among the prices of refined steels, nonferrous metals and certain plastics. A correct interrelating of these prices constitutes a major factor in either expanding or curtailing the application of substitute materials.

The influence of the pricing system on the purchaser's attitude is expressed in that he avoids or limits to the minimum the placing of orders for the superior and very expensive grades of quality steels. However this is not always justifiable, especially with regard to products which may be manufactured from brass or copper or corrosion-resistant steel. The fixing of the prices of corrosion-resistant steel at a too high level in relation to brass and copper might affect adversely the economic management of these latter metals because then purchasers would avoid using corrosion-resistant steels and try to replace them by brass or copper. In view of the definite scarcity of brass and copper, the relationship between the prices of corrosion-resistant steel and those of brass and copper should be, therefore, so established as to encourage purchasers to prefer the former. On the other hand the relationship between the prices of corrosion-resistant steel and those of plastics (e.g., vinidur) should be so established as to encourage purchasers to buy plastics, even if this were to necessitate the raising of the prices of such steel to a level somewhat above their prime costs or reducing the prices of plastics to a level somewhat lower than their prime costs.

This is because corrosion-resistant steels contain economically very valuable and scarce alloy admixtures, whereas the above-mentioned plastics are usually manufactured from domestically produced coal-derivative products.

Therefore brass and copper should be more expensive than corrosion-resistant steel (save for a few types applied for special purposes), while corrosion-resistant steel in turn should be more expensive than plastics.

However can the prices of all these materials be compared only directly? It appears that the answer is no. An additional factor to be considered is the quantity of substitute material that must be consumed instead of a specific quantity of the normally consumed material. Also it would be necessary to take into account the difference in production costs, caused by changing the raw material. However the best gauge of them all would be the finding whether the prime costs of products with identical uses (e.g., storage tanks of identical capacity) manufactured from corrosion-resistant steel, brass, copper, or plastics (e.g., vinidur) display a correct interrelationship owing to a correct determination of the relations among the prices of raw materials.

8. Prices of Hardware Scrap

Concept of hardware scrap. Economic expediency of the utilization of hardware scrap. Method of determining the prices of standard hardware scrap. Relations among the prices of individual groups of hardware scrap. Hardware scrap price levels and the utilization of that scrap by a minor industry.

In the Polish official price system a major role is fulfilled by the prices of utile waste. The correct determination of these prices affects considerably the degree of the rational utilization of utile waste in national economy. However this is not an easy

task and the pricing arrangements for many types of utile waste evoke reservations. This is because the viewpoints on methods of determining the prices of waste have not yet been crystallized. It appears that the currently official pricing arrangement for hardware scrap, as described in this section, is the most effective and consistent of all such arrangements.

Hardware scrap is an expression denoting utile wastes consisting of ordinary and quality carbon steels and refined (alloy) steel and caused during either the production or the dismantling of various equipment and facilities. Such scrap may consist of trimmings of sheets of various thickness, pipe sections, pieces of various fittings, and parts of equipment which cannot be used for the purpose for which it was designed.

Through the fullest possible utilization of hardware scrap in the manufacture of diverse products it is possible to reduce considerably the demand of many plants for deliveries from steel plants, and this creates the conditions for increasing output in those branches of industry where the volume of output hinges on the possibilities of obtaining sufficient supplies of rolled products.

Hence the utilization of scrap hardware increases the production potentiality of the country. All these economic advantages would be absent if steel wastes were consigned to ordinary scrap.

Although steel plants with open-hearth and electrical furnaces cannot operate without ordinary scrap, and the volume of steel output and, in turn, of the output of rolled products, depend among others, on the extent of ordinary-scrap deliveries --

it must be explicitly stressed that steel plants should be supplied only with the scrap that cannot be utilized as hardware scrap.

Accordingly the prices of hardware scrap should be an additional incentive for the most efficient possible utilization of such scrap. Therefore they should be correspondingly lower than the prices of full-value materials and higher than the prices of ordinary scrap.

As it is known, the prices of steel scrap differ not only depending on kind or grade but also on the nature of the plants purchasing or selling such scrap. A single type of hardware scrap is, for instance, sold by the plants of machine-building industry at a price different from that paid by steel plants. This is a reason for the considerable discrepancies among the price levels of various groups of hardware scrap. The related price list divides all hardware scrap into 4 groups, in accordance with the decrees governing the economic management of hardware scrap. The first 3 groups pertain to the so-called typical or standard hardware scrap, and the fourth to nonstandard hardware scrap.

The first group includes rods, fittings, pipes, and sheets. Some of these have an extensive area or length (the lower limit of these dimensions is specified in the price list) all of which are, properly speaking, obtained mostly from dismantling. As for rolled products having dimensions of similar largeness, industrial plants normally regard them as full-value materials usable for further production, and not as waste.

The second group comprises the rod, fitting, and pipe wastes found in the ferrometallurgical industry. Such waste is of smaller

dimensions than specified in the official rolling plans or catalogues, but nevertheless it is not smaller than the minimal dimensions specified in the price list of utile waste. This group includes also defective products of ferrometallurgy such as rods, fittings, and pipes of correct length but displaying surface or material defects which disqualify them, and sheets which cannot be cut owing to their area or surface and material defects.

The third group of hardware scrap includes the rod, fitting, pipe, and sheet wastes found in the production process outside the ferrometallurgical industry, provided that they are not shorter, nor have a smaller area (with respect to sheets), than the minimal length or area specified in the price list of utile waste.

The fourth group comprises all other kinds of utile hardware scrap. It may include rods from the first group which are shorter than the minimal length fixed for that group. It may also include damaged steam boilers, pieces of broken chains, and the like.

The above characteristics of each hardware-scrap group were taken into account when determining the prices of such scrap.

The first hardware-scrap price list was introduced in November 1954. Previously there were only the price lists of certain rolled products specifying the prices (usually in the form of a percentile discount from sales price) of the production waste found in the ferrometallurgical industry. In addition there were several loosely applied official prices, among others: (a) prices of standard hardware scrap (obtained from dismantling) purchased by stores of the Sales Bureau of the Central Board of Steel Marketing (these prices were fixed at the uniform level of 650 zlotys a ton);

(b) prices of railroad car axles obtained from the dismantling of obsolete rolling stock of the Polish State Railroads; and (c) prices of depreciated railroad wheel hoops.

A complete price list of hardware scrap could be drawn up only after determining the classification of that scrap and the general principles for its utilization -- this took place as late as in mid-1954.

The original price list was based on the following postulates.

1. Prices of hardware scrap in the second group should be comprised in the price lists of the rolled products of ferrometallurgical industry. The prices of production waste specified in these price lists should be acknowledged as the prices of hardware scrap in the second group.

2. Prices of hardware scrap in the second group should be determined on the basis of the same criteria as the prices of defective pig iron.

This principle was established in order that, on the one hand, the properly low prices would encourage purchasers to use defective pig iron and, on the other, these prices should not be lower than the costs of charge material, because otherwise the selling steel plant would rather prefer to use such pig iron in its own blast furnace charge.

The prices of such waste should not be lower than the prices of pig iron or ordinary scrap. If the price of pig iron is lower than its prime cost (this having taken place in 1955), the prices of hardware scrap in Group 2 should not be fixed at a level below

the prime cost of pig iron. Otherwise steel plants would find it more profitable to resmelt production waste in their steel-making departments than to sell it as hardware scrap.

However these prices should take into account the circumstance that the purchasers using Group 2 hardware scrap may sustain somewhat higher costs than when using full-value materials in the manufacture of their products. Therefore in a majority of cases, the prices of Group 2 hardware scrap are 20% lower than the prices of analogous full-value products. This discount is, on the one hand, high enough to discourage steel plants from manufacturing defective and below-standard-dimension rolled products and, on the other hand, low enough to make it more profitable to steel plants to sell their production waste and rejects than to resmelt them.

However it is to be emphasized that there also exist types of waste that -- if considered as hardware scrap -- would have to wait years for purchasers. In view of the great shortage of ordinary scrap metal, it would be more expedient to consign such waste to ordinary scrap.

In general it may be expounded that production waste of steel plants and other industrial plants should be considered as utile hardware scrap only whenever it is to be expected that such waste can be sold within a relatively brief period of time.

3. The prices of hardware scrap in Group One should be lower than the analogous prices in Group 2. This is because hardware scrap in Group 2 has a much higher utile value, even when its length or area are smaller than in Group One.

When production waste is purchased from a steel plant, the purchaser knows what grade of steel such waste derives from. Hence it is also possible to know the mechanical properties of such waste and this is of great importance to its reuse in production. On the other hand it is not possible to know the grade of steel in Group One hardware scrap which is acquired, for instance, through dismantling. Therefore the application of the latter scrap is more limited and in this connection its prices have been fixed at the level of 70% of the prices of analogous full-value type-sizes made from ordinary commercial steel.

However considering that price list items in Group One comprise a number of type-sizes, the prices of the cheapest type-sizes of analogous profiles were adopted as the basis on which to calculate the said 70%.

The prices of Group 3 hardware scrap were fixed at a lower level than the analogous prices of Group One scrap. True enough, the resulting price difference was not high enough to encourage purchasers to acquire Group 3 hardware scrap (nearly all purchasers tried to obtain chiefly Group One scrap), but it was not possible to increase that difference, unless industrial plants were to sell such scrap at ordinary scrap prices or at even lower prices.

The fixing of the prices of Group 3 hardware scrap at a too low level would be senseless because then the production plants, where such wastes are obtained, would not find it profitable enough to sort it out of ordinary scrap.

4. According to the price list, Group 4 hardware scrap should be sold at prices agreed upon between purveyor and purchaser, and

the minimum price should be 270 zlotys a ton while the maximum price should be about 70% of the price of full-value product. The price of 270 zlotys a ton is higher by 20 zlotys than the price receivable by purveyor for the most expensive (light) nonalloy steel scrap if he were to sell it to a socialized scrap warehouse.

The upper limit of the prices of Group 4 hardware scrap has not been specified in absolute figures, because -- as noted before -- this group may also comprise dismantled or damaged equipment the value of which cannot be appraised in advance.

Likewise it was not possible to establish the principle of selling Group 4 hardware scrap at a fixed ratio (e.g., 70, 60, or 50%) to the price of full-value product. This is because sometimes the purchaser must accept the risk that the hardware in the group may prove unsuitable for processing and will have to be resold at the price of ordinary scrap. All such cases must be individually considered; therefore it was necessary to confer some flexibility on the prices payable for Group 4 scrap hardware.

The 1956 price list of hardware scrap has been partially modified. Owing to the raising of the prices of rolled products there occurred a concomitant increase in the prices of the production waste and rejects of ferrometallurgical industry, although the percentile ratios of discount from prices of full-value products remained nearly unchanged.

The prices of Group One hardware scrap have increased upon preserving the principle of the 70% for the price of full-value product.

On the other hand, the prices of Group 3 scrap were maintained unchanged and so was the principle that the prices of Group 4 hardware scrap should be determined between the purchaser and the producer themselves.

The maintenance of unchanged prices of Group 3 hardware scrap was designed to create a high enough difference between the prices of that scrap and the analogous prices of Group One scrap.

The low prices of Group 3 scrap (in some cases amounting to as little as 25% of the prices of full-value products) should constitute sufficient attraction for many purchasers. By utilizing hardware scrap from that group they can reduce substantially the prime costs of their production in relation to the costs they would have sustained if using hardware scrap from other groups or from other groups or from full-value rolled products.

There is no doubt that such a determination of hardware scrap prices will contribute to increasing the demand for and use of hardware scrap in general and this should effect a considerable reduction in the shortage of rolled products.

CHAPTER III. PRICES OF NONFERROUS METALS

1. Prices of Ores of Nonferrous Metals

Principal kinds of ores of nonferrous metals. Determining the formula prices (prices depending on the content of pure metal in ore). Influence of variable (formula) prices of ores on the profitability of nonferrous ore mines. Prices of nonferrous ores and the economic profitability of mines.

When speaking of the price of a given material or a means of production we usually refer to the specific monetary amount which the purchaser is to pay for a natural unit of such material. Therefore the price list expresses prices most often in amounts of zlotys per kilogram, per ton, per linear meter, square meter, cubic meter, liter, piece, etc. The prices of wholly replaceable assortments of products are determined in the same way, even when the principle of equivalent relationship is adopted as the basis.

However the official pricing system for metallurgical industry applies other solutions, too. This section will use the prices of the ores of nonferrous metals as an example to show how in certain circumstances (when the prices should be fixed according to the principles of equivalent relationship) it is possible and expedient to determine each and every time the value of the delivery of a given material according to appropriate formula and not to list prices.

In the Polish output of nonferrous metals the principal role is occupied by ores of zinc, lead, and copper. Extensive deposits of zinc ores -- zincblende and calamine -- occur in Upper Silesia and in the vicinity of Olkusz in Poland. Zinc-ore deposits are usually accompanied by lead-ore ones in the form of galena; therefore they are together referred to as zinc-lead ores when determining their prices.

In view of the contiguous occurrence of zinc and lead ores and their high content of gangue, the extracted zinc-lead ores are subjected to various concentration processes resulting in the separation of galena from zinc ores and the elimination of the considerable content of clay, silica, and other impurities. What remains

is the so-called concentrates of zinc and lead, distinguished by their much higher content of pure metal. Depending on the quantity of pure metal in a ton of raw ore and on the type, method, and manner of conducting the concentrating processes (e.g., flotation, roasting, or sintering) the concentrates obtained vary in their content of pure metal and in their chemical composition (zinc sulfides and oxides, and lead oxides). As a result the processing costs and the consumption of concentrates in the metallurgy of nonferrous metals per ton of given pure metal (zinc, lead, etc) fluctuate considerably depending on the content of pure metal and chemical composition of the concentrate.

The above statements concerning zinc-lead ores are equally applicable to copper and aluminum (which must undergo the concentration process) and to other ores of nonferrous metals.

Although the volume of yield and the processing costs per ton of pure metal depend considerably on the degree of modernity of metallurgical facilities and production methods [see Note], the chemical composition of a concentrate and its content of pure metal are here always the factors of primary importance. The share of material costs in the total prime cost of the production of pure metal is, as a rule, very considerable and sometimes it would even be greater if the price of ore were to take into account the complete costs of its extraction and concentration.

([Note] For instance the prime cost of the production of a ton of electrolytic zinc is much lower than the prime cost of the production of a ton of metallurgical zinc, although electrolytic zinc is of much higher quality.)

As noted before, there are many reasons (to be mentioned later) why the mining of the ores of nonferrous metals cannot always be financially profitable.

In view of the great fluctuations in the pure-metal content of an ore delivered in installments throughout a prolonged period of time (even if such ore derives from one and the same mine), it is necessary to solve this problem: which branch of industry should be selected for eliminating therein the fluctuations in profitability caused by the varying chemical composition of ore, the nonferrous ore mining industry or the nonferrous metals industry? A number of reasons prevail in favor of making the evolution of prime costs and profitability in the nonferrous metals industry independent from the often accidental changes in the quality of the delivered ores and their concentrates. It appears that the following are among such principal reasons.

(1) The concentrates of a given ore are interchangeable but the volume of their consumption per ton of finished products depends on the content of pure metal in the given concentrate.

(2) The quality of the delivered ore concentrate and -- what is very important -- the percentile content of metal therein are in no way subject to the purchaser's influence; they are largely dependent on the manner of the process of ore concentration applied by the ore mine, and on the thoroughness of that process.

(3) In the nonferrous ore mining industry the problem of profitability (to be discussed later) cannot and should not occupy as important a place as it does in the metallurgical and other branches of industry where the financial profitability of an enterprise is one of the principal indexes of its worth and economic usefulness.

All these circumstances speak in favor of determining the prices of nonferrous ores according to the principles of equivalent relationship. The price of a ton of the pure metal should be adopted as the basis of that relationship, while the equivalency index should consist of the percentile content of pure metal in ore, in ore concentrate, in semifinished product, or in the waste arising during the process of the production of nonferrous metals. On the other hand the specific character of that relationship consists in that, in addition to the above mentioned values, the calculations should also take into account the costs of separating from a given ore (or concentrate, semifinished product, or waste) the pure metal, and the losses of metal occurring during the production process. This is because the percentile content of pure metal in an ore does not in itself express the ratio of the utile value of ore to the utile value of the obtained pure metal. The index of equivalent relationship should equal 1.0 because it would not be expedient to fix ore prices at a level that would assure additional profits to the nonferrous metals industry (if the index is less than 1.0) or cause the nonprofitability of that branch of industry (if the index is higher than 1.0 -- when the equivalent relationship index equals exactly 1.0 it can be generally ignored when determining prices).

However there arises the question whether it is pertinent to compute in advance the price of each and every kind of ore, concentrate or other material yielding ingots of metal with varying contents of pure metal? Such computing is generally regarded as unnecessary, especially as a price list prepared in this way would contain a great number of items, because even minute differences in the content of pure metal (expressed in fractions of a percent) exert

a considerable difference on the utile value of a given ore and the height of its price.

An additional difficulty is that some ores contain 2 or more metallic elements.

There is hence no price list specifying the sales prices of these raw materials. Instead there are formulas used for calculating individual sales prices according to the results of the so-called "analysis" of a certain ore, concentrate, semifinished product, or waste.

The formulas drafted for the year 1956 take into account the following parameters serving to determine the prices of products:

(a) price of the metal contained in a given product, corresponding to the sales price fixed for the given metal in ingot form (designated by symbol P in the formula);

(b) analytic percentile content of metal in product, i.e., percentage indicated by laboratory examination (designated by symbol $\frac{T}{100}$ in the formula);

(c) percentile content of metal agreed upon periodically between producer and purchaser, for accounting purposes (calculated by deducint units of metal loss -- caused by further processing of product -- from the mean analytic percentile content of metal during a given period of time -- symbol: $\frac{T - x}{100}$);

(d) costs caused by further processing of the given product into pure ingot metal, as expressed in the form of a decimal fraction of the price of pure ingot metal (symbol: $\frac{J}{100} \times P$);

(e) additional coefficients represented in the form of a given decimal fraction (symbol: $\frac{Z}{100}$), and expressing technological value in relation to other similar product (e.g., technological value of roasted and sintered zincblende in relation to such zinc concentrates as utile zincblende and sintered zinc oxide), for which the basic price formula has been determined.

Accordingly the over-all scheme of the formula for determining the sales price of a specific nonferrous ore, concentrate, semi-finished product, or waste may be expressed as follows:

$$P \times \frac{T - x}{100} - \frac{J}{100} \times P$$

or

$$\frac{Z}{100} \times \left(P \times \frac{T - x}{100} - \frac{100}{J} \times P\right)$$

This does not mean that these expressions are applicable in all formulas; in certain cases a formula expresses the specific traits of a given product or the conditions of its processing in a form different from the above over-all schemes.

Regarding the products whose further processing will yield not one but several metals other expressions have been introduced in the formulas so as to facilitate the appraisal of each of these metals and thereby the computing of the price of the multiple-metal product. Such products are, among others, raw zinc-lead ore, argentiferous foam [piana], brass ashes, and a number of others.

According to the regulations for the year 1956 (and subsequent years) the analytic percentile content of metal in the product sold is agreed upon periodically between purveyor and purchaser on the basis of an exchange of analyses made by their respective laboratories. In this way extremely complicated calculations for each delivery are rendered unnecessary.

The extent of metal losses adopted for computing the contractual percentile content of metal in a given product does not have to be determined anew every time the purveyor and the purchaser settle their accounts.

Empirical data were used as the basis on which to determine for every individual product a definite extent of metal loss during the concentrating or metallurgical process. This extent was adopted as a constant value and introduced as such into the formula. If, however, after a period of time during which the formula is applied, it is found that the achieved technological indexes of yield necessitate a revision of the said extent of metal loss (as postulated in the formulas), then both the purveyors and the purchasers are entitled to request the State Economic Planning Commission for introducing proper modifications in the formulas.

Generally speaking it may be stated that the system of formula prices of ores of nonferrous metals insures the profitability of the production of pure ingot metals and, if the prices of the processed products of nonferrous metals industry take into account the costs of processing departments, this will also insure the profitability of that industry as a whole.

On the other hand, the matter is quite different so far as the nonferrous ore mining industry is concerned. Geological conditions and other objective reasons may cause such phenomena as a decline in the metal content of an ore and a concurrent increase in the costs of its extraction. Converse cases may also occur. However these occur more rarely because, with the present trend for insuring Poland with the greatest possible quantity of nonferrous metals, extracting operations are now extended also to those mines

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which were once considered by capitalists as nonprofitable and, as such, abandoned or flooded.

The desire for obtaining the greatest possible yield of metal in the concentrate causes the application of often expensive chemicals in the ore concentration processes (flotation, for example), whereby the concentration costs are increased. In this connection it may be found that the value of the metal (as per the formula) after concentration will not cover the increased costs of that process. However this does not mean that in such a case these methods of production should be generally abandoned. Aside from the problem of financial profitability the problem of economic profitability is of much greater importance with respect to the nonferrous ore mining industry.

This is because the fullest possible utilization of the domestic base of natural resources will allow national economy to be supplied with a greater quantity of nonferrous metals, which are indispensable to modern industry, especially to machine building, electrical engineering, power, and chemical industries. Thus the uses of nonferrous metals in the national economy are extremely variegated.

Accordingly the pricing system for nonferrous metals must fulfill a somewhat different role in relation to the nonferrous ore mining industry than does the pricing system in other branches of industry. The prices and the degree of profitability achieved should not affect considerably the selection of methods, types, and sites of the extraction of nonferrous ores. For instance if the copper ore mines sustain higher losses than the zinc-lead ore mines, this may not be a reason for abandoning the exploitation of copper ore

mines. Likewise if one of the deposit seams contains a smaller percentile content of metal, its extraction may not be abandoned in spite of its decreased profitability. Also the higher costs of certain ore concentration methods should not be a reason for abandoning their application, if such methods cause a considerable increase in the yield of metal and if they do not require the use of scarce imported chemicals.

The prices at which the nonferrous ore mining industry sells its products should not be of too great an importance. Aside from the fact that they fulfill a certain role as a factor in settling accounts with the nonferrous metals industry, the formula prices of nonferrous metals industry have only one other economic task to fulfill: they should protect steel plants from receiving ores or concentrates containing excessive percentage of gangue.

The appropriate economic authorities should, however, be vigilant to avert cases in which the pricing system in the nonferrous ore mining industry might follow an economically undesirable trend; that is, when certain enterprises of that industry, being desirous to improve their financial profitability, might attempt -- instead of increasing their labor productivity, utilizing materials more efficiently, and reducing their administrative costs -- to operate their mines on an unsound quick-profit basis and to reduce extraction in certain mines or deposit seams.

2. Prices of Nonferrous Ingot Metals

Concept of nonferrous ingot metals. Pricing system for nonferrous metals as an incentive for economy in their use. Relations among the prices of various types of nonferrous

metals. Determining the prices of domestic and imported raw materials according to their actual purchase prices. Purchase prices of nonferrous metal scrap. Sales prices of nonferrous metal scrap.

The previously discussed problem of preserving a proper relation among the prices of products manufactured from diverse raw materials pertained to products that are wholly or partially replaceable. However there are cases when it is necessary to determine the relation among prices of products that are hardly or not at all replaceable. The prices of certain kinds of nonferrous ingot metals may serve as an example.

Nonferrous ingot metals are metals in a pure (homogeneous) state and in the form of rectangular or rounded ingots. Sometimes these ingots also have the form of a breadloaf and are colloquially termed "wirebars." Nonferrous ingot metals are divided into kinds and -- considering the content of the pure element -- grades. The number of kinds of nonferrous ingot metals nearly corresponds (because iron is not among them) to the number of metals as chemical elements.

The importance of nonferrous metals to national economy has already been metnioned. Mention has also been made of the scarcity of these metals and the necessity to save them. Here it should be added that the pricing system should be among the factors most encouraging the enterprises to save nonferrous metals. However this system must be so arranged as to encourage the replacing of certain metals by plastics or by other more easily accessible metals. With respect to metals that are both irreplaceable and scarce in the

national economy, the pricing system should stimulate purchasers to consume such metals as thriftily as possible.

These postulates should be taken into account when determining the prices of nonferrous ingot metals; they should be based on economic policies in such a way that even if the prices of the alloys and rolled, stamped, and forged products from these metals be fixed at the level of prime costs the economically correct interrelationship of prices would be preserved. This is because nonferrous ingot metals constitute the charge for the manufacture of these products, and in this case the price of charge is of decisive importance to the height of prime cost.

In order to realize the above described postulates, the 1956 prices of nonferrous ingot metals were thus determined.

Metallurgical zinc has been selected as the typical or standard Polish nonferrous ingot metal, as Poland is one of the world's greatest zinc producers. The price of metallurgical zinc was fixed at a level similar to that of its prime cost. However this does not appear to be quite justified. This is because in certain cases it is feasible to replace zinc by steel, and conversely. The zinc production costs in Poland are relatively low, and therefore the price of that metal, as based on its prime cost, is too low especially when compared with the price of ordinary carbon steel.

The world market price of zinc is 4 or 5 times as high as the price of that steel (see Gepner, Jozef, Metale niezelazne [Nonferrous Metals], 1954, Polskie Wydawnictwa Gospodarcze Publishing House, page 76), whereas in Poland it is only 2 or 3 times as high. If it be considered that zinc, being a metal softer than steel, is

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more easily machinable, it is clear why certai products, such as keys, paper clips, etc, are manufactured from zinc rather than from steel.

It has been found that even the price rationing of zinc as a nonferrous metal is not always effective and in certain cases the use of zinc is not justified by any actual need. True enough Poland is among the world's greatest zinc producers; nonetheless it is necessary to apply restrictions in the consumption of that metal because it is a valuable and scarce metal, very much sought after on the world markets. Its use should be permissible only whenever it is truly necessary or whenever it can replace other, still more scarce nonferrous metals. However ordinary carbon steel should in no case be replaced with zinc.

There is no doubt that the too low difference between the price of zinc and that of steel reflects adversely on the saving of zinc in national economy. Besides the low level of zinc prices may also reflect adversely on the relations between the prices of other nonferrous metals and the price of ordinary carbon steel. This is because the prices of the other nonferrous ingot metals (with a few exceptions) have been related to the price of metallurgical zinc. The price of electrolytic zinc as well has been determined on the basis of that relation because the prime cost of electrolytic zinc (as the cost of the most modern method of zinc production) is much lower than the prime costs of metallurgical zinc. On the other hand the quality of electrolytic zinc is much higher than that of metallurgical zinc. If in this case prices were to be interrelated according to their prime costs, the purchasers would demand electrolytic zinc only, whereas economic considerations dictate the production of both electrolytic and metallurgical zincs.

Likewise the prices of other metals had to be related to the price of metallurgical zinc. However this task proved more difficult. For instance what criterion should be applied for comparing the utile values of zinc and aluminum, zinc and lead, and so forth?

The comparison of the utile values of copper and aluminum is much easier. Namely one could compare the property for conducting electrical current as displayed in both metals and, upon taking into account their specific weight, determine the length of the wire which would be manufactured from a ton of aluminum if that wire is to have the same electrical conductivity as a specific length of wire manufactured from a ton of copper. The ratio of the lengths of both these wires will correspond to the ratio of the utile values of a ton of copper and a ton of aluminum.

This method of comparing utile values is, of course, somewhat oversimplified; nonetheless it suffices for determining the basis for interrelating the prices. This does not signify that the relationship between the prices of both these metals should correspond exactly to the numerical ratio of their utile values as calculated in the above described manner. If copper is a more scarce metal than aluminum, the numerical ratio of the price of copper to that of aluminum should be higher than might be concluded from a comparison of their utile values, and conversely.

The above principle does not, however, solve the problem of the ratio of the price of aluminum to that of zinc. The use of a comparison of their respective production costs as the basis for calculations would not be pertinent in this case. In practice (while drafting the 1956 price list) the solution applied was first

to determine the indexes of relationship which should apply between the prices of individual nonferrous ingot metals and the price of zinc. In this connection use was made of the Soviet method of price interrelating, upon adapting it to the specific Polish conditions. In this way through interrelating the prices of various nonferrous ingot metals with the price of metallurgical zinc, it was possible to determine also the price level of the former.

However the fixing of zinc prices at a too low level entailed also the low pricing of certain nonferrous ingot metals, such as lead, which in Poland is a scarce material. The price of lead on the world market is 5.3 times as high as the price of ordinary carbon steel in undressed state, whereas in Poland it is only 4.6 times as high.

With respect to certain imported metals, their prices could not always be related to the price of metallurgical zinc. Hence it was necessary to find another interrelation, namely, the prime costs of the production of the commodities which Poland must earmark for export in order to buy abroad a ton of a given metal were computed, and the price of the imported metal was fixed at the level of such combined prime costs. For instance (arbitrary figures): the Poles receive $12 from abroad for every ton of coal they export. Now the purchase of a ton of X material from abroad costs $120. The prime cost of a ton of coal amounts to 50 zlotys. Accordingly, in order to buy a ton of X material from abroad, Poland must sell 10 t of coal. The prime costs of 10 t of coal total 500 zlotys. Therefore the purchase of a ton of X material from abroad costs Poland's economy 500 zlotys, and the sales price of X material would be fixed at the same amount, if it is a supply or investment material.

When nonferrous ingot metals are discussed, mention must be also made of nonferrous metal scrap, which is partly used instead of ingot metals in the nonferrous metals rolling mills, and partly serves to obtain (upon refining) ingot metals.

There are the following different purchase prices of nonferrous metal scrap: prices payable to private owners, prices payable to social organizations, prices payable to socialized warehouses, and prices payable to socialized industrial plants.

The prices payable to the public and to socialized warehouses were determined on the same principles as the steel scrap prices. However they were somewhat modified in accordance with specific economic policies of the state on this sector.

The prices payable to industrial plants, for nonferrous metal scrap, were approximated to the level of scrap sales prices (provided that the classification of scrap be fully preserved and impurities be avoided), and thus were made quite attractive. In this case the question was not so much to stimulate the plants to deliver their scrap (this is governed by very rigorous laws) as to encourage them to deliver scrap in the purest possible and properly classified form. This is of enormous technical-production importance to the nonferrous metals industry, which receives that scrap.

3. Prices Applied in Nonferrous Metals Processing Industry

General characteristics of the processing of nonferrous metals. Price interrelationship in the processing industry.

When prices are determined according to the principles of direct relationship, it often happens that the range and variety of

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forms of a given product is very extensive. Hence the computing of the prime costs of every individual form would require unusually great labors. On the other hand the absence of technological norms of labor productivity and yield makes it impossible to formulate normed costs in a more simplified manner. A situation of this kind has appeared when determining prices in the nonferrous metals processing industry.

Processing of nonferrous metals comprises casting of alloys of nonferrous metals, plastic processing of these metals through rolling, forging and stamping, and the manufacture of metal powders.

As noted before the problem of a proper interrelating of the prices of individual kinds of nonferrous metals has been expressed in the determination of the prices of nonferrous ingot metals. The prices of the products of the nonferrous metals processing industry should, therefore, be determined according to the principles of direct relationship.

The 1956 prices of individual type-sizes of rolled, drawn, and forged products were fixed upon determining the prime costs of production of selected "representatives" in each given group of type-sizes (on the basis of the level of costs in the standard plant), and the prices of these "representatives" were determined on the same level as that of their prime costs. Next, through interpolation, the prices of the other type-sizes were determined.

Product A	Prices of "Representatives"	Prices From Interpolation
(1) 10 mm thick	24 zlotys a kg	
(2) 15 mm thick		20 zlotys a kg
(3) 20 mm thick		16 zlotys a kg
(4) 25 mm thick	12 zlotys a kg	

Norming calculations were not used because no data were available concerning the labor productivity and yield involved in individual products.

The correctness of that method is somewhat undermined by the following speculations.

(a) Is it right to adopt planned cost instead of normed cost? (Planned cost may include diverse nonstandard circumstances resulting, e.g., from temporary difficulties in a given plant.)

(b) The level of the prime costs determined for specific type-sizes on the basis of the planned cost of the group as a whole may be computed only on the basis of contractual coefficients, while the coefficients hitherto applied for this purpose have often proved to be not wholly correct.

(c) The interpolation method does not reflect completely the increase in prime cost caused by the thinner dimensions of a given product.

Hence it appears that the application of the method cited for determining the prices of cogging mill products would be expedient also with respect to the products of the nonferrous metals processing industry.

However it is to be stated that it was necessary to apply the method described on the preceding page in the present situation where no conditions exist as yet for determining the normed costs of individual assortments. Nonetheless any future revision of the prices of nonferrous metals should be preceded by creating these conditions, especially by working out the technological norms of human and mechanical labor productivity and the yield norms.

CHAPTER IV. PROCESS FOR ADMINISTRATIVE DETERMINATION OF THE PRICES OF SUPPLY AND INVESTMENT GOODS IN METALLURGICAL INDUSTRY

The procedure and powers concerning price fixing, like any other activities connected with the administration of the national economy, must be comprised in the tight organizational forms defined by appropriate legal provisions.

A particularly vital importance is ascribed to the division of powers concerning price fixing, as carried out on the basis of the appropriate norming regulations. These problems are the topic of this chapter.

The authority appointed for fixing the prices of supply and investment goods is the State Economic Planning Commission /see Note/. The commission determines these prices on the basis of the directives of the Council of Ministers, which is the supreme authority in Poland so far as price fixing is concerned.

(/Note/ See decree of 3 June 1953 concerning the determination of prices, fees, and scheduled rates, Dziennik Urzedowy /Legal Gazette/, No 31, Item 122; Resolution No 406 of the Council of Ministers of 3 June 1953 concerning the powers of the authorities to determine certain prices, fees, and scheduled rates and to outline the directives for their determination (including later modifications), Monitor Polski /Polish Monitor/, 1953, No A-57, Item 722; No A-96, Item 1336; No A-115, Item 1495, and 1954, No A-50, Item 683.)

The concept of "supply and investment goods" is construed as referring to means of roduction assigned for consumption within

the socialized sector of economy [see Note], and certain goods assigned exclusively for supplying budget units.

([Note] See Rotsztejn, Boleslaw, "The Authorities, Fundamental Principles, and Procedures for Determining the Prices of Means of Production," Przeglad Ustawodawstwa Gospodarczego [Economic Legislation Review], No 4(82), page 121.)

The chairman of the State Economic Planning Commission is authorized to delegate certain price-fixing powers to the appropriate ministers and directors of central offices and presidiums of people's councils, as far as some supply and investment goods prices and scheduled rates and fees are concerned. Therefore the chairman has delegated to individual ministers chiefly the powers concerning the determination of the prices of services and of all nonstandard articles [see Note] manufactured by enterprises subordinated to these ministers (Monitor Polski, No A-94, Item 1311, 1954).

([Note] The related ordinances of individual ministers specify how "nonstandard services and products" should be construed. For instance in the Ministry of Metallurgy such products may be air-blast machines for blast furnaces, and diverse kinds of forgings whose production is limited and not repeatable.)

The executive ordinances of individual ministers specify the limits of the value of orders within which the prices of nonstandard products and services may be agreed upon between the purveying and the purchasing plant, and cases when these prices should be determined on the basis of an understanding between the authorities to which the purchasing and the purveying plants are subordinated.

The industrial units under the jurisdiction of the Minister of Metallurgy do not have to submit their prices for confirmation to their superior units when the purchasing plant with which a price is agreed upon is also subordinated to the Minister of Metallurgy.

Pursuant to the regulations in force, the prices of nonstandard products and services should be in principle fixed at the level of planned prime costs plus a 5% profit. This does not pertain to cases when, in view of their relation to the prices of similar products, the prices of nonstandard products have to be fixed at a different level.

For instance, if the price lists in force mention products belonging in the same group as a given nonstandard product, and the prices of these products are somewhat lower than their prime costs, the prices of the given nonstandard products should be fixed in an analogous ratio to their prime costs. On the other hand, if a nonstandard product differs in execution or attachments from other products in the same group, whose prices are specified in official price lists, the price of the nonstandard product should be correspondingly higher.

Control on the part of the purchasers should be a factor in insuring the correct determination of the prices of nonstandard products and services, inasmuch as the purchasers are interested in the lowest possible pricing of such products and services. Therefore they should be assured of the right to verify the producer's calculations. However it is to be stated that the regulations governing the fixing of the prices of nonstandard products and services are not always observed. Sometimes producers do not let

purchasers verify the calculations of the planned prime costs of a given service or product. Likewise when orders are placed producers do not always agree upon prices with purchasers. In this way producers want to protect themselves in the event that -- owing to unforeseen circumstances -- the resultant prime costs prove to be considerably higher than planned.

A no lesser importance is ascribed to the fact that, pursuant to regulations in force, the computing of planned prime costs should take into account planned data concerning yield, labor productivity, etc, whereas actually the plans are not always fulfilled in this respect.

In this connection many producers, when orders are placed with them, delay presenting calculations of planned prime costs to purchasers and agreeing with them on prices. It is only after the order is executed, that is, when the resultant prime costs are known, that they send calculations to purchasers and also enclose their price proposals. In such cases the purchaser is unable to determine whether and to what degree the resultant prime costs diverge from planned ones. Through such methods producers attempt to transfer to purchasers the burden of any losses, even losses resulting from ordinary squandering of materials, tools, and human labor. Such practices on the part of producers affect the purchasers very adversely with respect to the fulfillment of their own plans of prime costs, financial plans, investments, etc. These practices should be contradicted with all sharpness; managers of enterprises which consciously and deliberately delay presenting calculations should be made responsible for such delays.

Although official regulations govern explicitly the problem of nonstandard goods, there are still cases when products manufactured on a periodic and serial basis are marketed as nonstandard products. Such cases occur chiefly because in nonstandard production certain purveyors attempt to obtain higher profits than in standard production. Such attempts purport to obtain the highest possible price even when objective reasons do not justify this. Sometimes it also happens that purchasers are under compulsion because the producers may refuse to accept an order if they cannot receive a high enough price for a given product. Such practices may be considerably reduced through introducing a more effective control of the determination of the prices of nonstandard products. Nonetheless the most effective way of counteracting such headlessness on the part of producers would be to apply permanent sales prices to all products manufactured serially and periodically.

The sales prices specified in price lists must be binding for all state enterprises of major industry. For instance pig iron, steel, or rolled products manufactured in enterprises subordinated to the Ministry of Machine Building Industry must be sold at prices specified in the price lists of the Ministry of Metallurgy. Analogously, steel plants and coke-chemical plants subordinated to the Ministry of Metallurgy must sell coke at prices specified in the price list of the Ministry of Mining, and coal derivatives at prices specified in the price lists of the Ministry of Chemical Industry.

The generally applied principle is that the price lists of individual commodities are to be issued by the ministry which exercises jurisdiction over the main distributor of these commodities. These price lists are issued subject to approval by the State

Economic Planning Commission which, as noted before, is the appropriate authority for determining the prices of supply and investment goods, no matter whether they derive from domestic production or from imports.

It must be emphasized that the powers of the State Economic Planning Commission to determine prices are much more extensive. They also comprise the prices of regenerated raw materials, commodities assigned for exports (means of production and consumption), scheduled rates for shipping parcels by enterprises of socialized economy, and prices and fees for deliveries, jobs and services rendered within the framework of socialized economy, except the prices of construction and assembling assignments (see Rotsztejn, Boleslaw, op. cit., page 122).

Aside from having delegated to appropriate ministers powers to determine the prices of nonstandard goods and services, the State Economic Planning Commission has also delegated to certain ministers -- including the Minister of Metallurgy -- its powers to determine the prices of supply and investment goods which are manufactured by plants subordinated to a given ministry and sold only to other units subordinated to that ministry. This pertains chiefly to semifinished and finished products delivered within the framework of interplant cooperation (Ibid., page 125).

However one minister cannot determine the prices of products manufactured by enterprises subordinated to him and sold to other such enterprises when these products are also manufactured by enterprises subordinated to another minister, and when generally binding sales prices have been specified for them.

The above mentioned powers are of a permanent nature. That is, a minister is free to alter prices whenever necessary.

On the other hand the problem of complementing the official price lists for key industry with new prices is a different matter.

The chairman of the State Economic Planning Commission, upon delegating some of his price-fixing powers, has authorized certain ministers to fix the prices of the investment and supply goods that are produced in their plants for the first time (except for certain specified articles whose prices are fixed by the commission). In this connection a vital importance is ascribed to the fact that the prices of goods sold to purchasers from other ministries should be agreed upon with the minister to whom the chief purchasers are subordinated. If a principal distributor is subordinated to a minister other than the minister to whom the producer of a given product is subordinated, the newly fixed price should be also agreed upon with the principal distributor.

These regulations purport to exclude cases when prices would be fixed for a narrowly conceived benefit of the producer, without taking into account the attitude of the purchaser.

The likelihood of fixing prices at too high a level is also prevented by the provisions contained in appropriate ordinances of the chairman of the State Economic Planning Commission (delegating price-fixing powers to ministers), which obligate individual ministers to revise the newly-fixed prices after a quarterly period, or before the elapse of 7 months if they were fixed on the basis of prime costs. Such revisions are conducted on the basis of resultant calculations.

The fixing of the prices of certain novel products is not among the powers of individual ministers. This pertains to products whose prices affect decisively the level of costs and the value of output, with the level of the prices being connected to a definite economic policy of the government. In the Ministry of Metallurgy such products originate from ores of iron and nonferrous metals, nonferrous ingot metals, all kinds of scrap, pig iron, cast steel, semifinished rolled products, and steel structures.

CONCLUSION

Until recently certain economists expounded the theory that in the conditions of a planned material economy and a centralized distribution of supply and investment materials, price becomes merely an accounting prop, while the height of price or the relations among the prices of different materials are of no great importance to socialized enterprises.

It must be admitted that this viewpoint contains a grain of truth. But the essence of the problem was not a diminution in the importance of price in the conditions of a planned socialist economy where state enterprises may and should essentially receive their materials on the basis of ration assignments. What happened was that the pricing system could not fulfill its role adequately because the problem of reducing prime costs and increasing the profitability of enterprises was not a center of attention to certain economic activists. The struggle was concentrated on the sector of attaining the proper volume of output, without considering how much it would cost and what value would it actually represent. Many enterprise managers attempted to obtain greater assignments of materials without devoting sufficient attention to their thrifty consumption.

At present such situation has been overcome to a great degree. All enterprises, with a few exceptions, devote increasing attention to the struggle for the reduction of prime costs and improvement of financial results. Doubtless this was stimulated by, among others, the application of economic incentives such as the introduction of the plant fund and of bonuses for reduction of prime costs. Of great importance also was the increase in the political awareness of plant crews, and the active participation of social organizations in the struggle for a reduction of prime costs. In this connection there also occurred an increase in interest in the problem of the prices of means of production because of its close relation to the evolution of prime costs.

It is to be expected that the decisions concerning the prices of means of production will cause a more efficient management of socialized enterprises. This is because individual enterprises, in their desire to reduce their prime costs, will have to take care to use the cheapest raw and other materials and to observe and consistently reduce the norms of material consumption. In these conditions the role and importance of economic accounting will also increase, especially considering that the price system will exert a greater influence not only on purchasers but also on producers.

As noted previously, it is difficult to incline industrial plants to fulfill their plans of range and variety of output when the price system exhibits a contrary trend. The output of some goods would then assure high profits, and that of others -- much smaller profits if not even losses. Such occurrences may be considerably averted through selecting a proper price-fixing method. However in this connection some attention should be turned to the

possibility of transferring the manufacture of certain more expensive assortments to plants which can perform it more cheaply.

When determining the relations among the prices of individual assortments belonging in a single commodity group, attention should be also turned to the possibility that certain plants could specialize not only in the production of specific commodity groups but also of specific products comprised within a given group. In such cases the prices of individual products included in a specific commodity group should be based on the costs of the plants specializing in the manufacture of a given product, and not on the mean weighted costs or standard plant costs.

The price system also occupies a major role in the struggle for raising the quality of production. Cases still happen when official price lists do not provide a price discount for second-class goods. This is because the price lists were based on the assumption that products should be only of a first-class nature, and that otherwise they have no utile value (for the purpose for which they were manufactured). However this is not always correct. A purchaser who has no opportunities for acquiring a given product from another enterprise must sometimes accept a product of inadequate quality. If, in addition, the given product is of an economically scarce character, and the producer can be certain of always finding a purchaser for it, the absence of a fixed discount price for the second class product is doubtless a factor weakening the struggle for raising the quality of production.

The height of the discount price for second class products should also be considered. If an enterprise finds it relatively profitable to manufacture a given product, it may happen that even

if a discount price of 10 or 15% is set for second class forms of the products, the prime costs of production still will be covered. In such a case the pricing system is less effective as a factor raising the quality of production. It appears advisable to introduce the principle that the discount rate for second class products should be lower than the prime costs of their production (in this place only supply and investment goods are referred to, as their sales prices do not include turnover tax).

An increase in the importance of the pricing system for supply and investment goods involves an increase in the importance of the proper determination of the price level. Improperly determined prices affect -- as was often emphasized -- very adversely the proper utilization of means of production, rational use of raw and other materials, fulfillment of plans of range and variety and output, and materialization of supply plans, etc.

However the height of a price cannot be correct unless it is determined on the basis of the method most appropriate for the branch of industry concerned. This is closely connected to the selection of the type of relationship of prices. Prices are determined most often on the basis of either direct or composite relationship which are essentially based on prime costs. Direct relationship finds application mostly for not mutually replaceable and hardly replaceable goods. This is not an absolute rule, as it was pointed out in the discussion of the prices of ferroalloys where some of the prices were determined according to the principles of direct relationship although they pertain to wholly replaceable goods. In this connection it was also pointed out that if a purchaser has complete freedom in selecting mutually replaceable

materials, their prices should be fixed according to the principles of direct, and not composite, relationship.

Composite relationship, although also based on prime cost, has a different character than simple relationship. The former is applied whenever it is desired to fix prices so as to cause variations of different quality, when manufactured with identical equipment, to be produced in highest quality only.

As noted before, both direct relationship and composite relationship are based on prime cost. This means that a certain definite relation should exist between the price level resulting from either of such relationships and the prime cost. This relation or ratio is expressed by the index of direct relationship or index of composite relationship. As was pointed out previously, these indexes should generally equal 1.0 or 1.05 (in case of products the expected prime costs of which cannot be reduced in the immediate future). This signifies that price should generally equal prime cost and eventually prime cost plus 5% profit. This principle appears to be indisputable. It has been theoretically justified by a number of economic studies [see Note]. This book also has propounded arguments in favor of the application of this principle.

([Note] See Lipinski, J., "Some of the Problems of the Prices of Means of Production," <u>Ekonomista</u> [Economist], No IV, 1954; and Fiszel, H., "Price Versus Profitability," <u>Finanse</u> [Finance], No 1, 1955.)

It would be also worthwhile to note the importance of the leveling of prices with prime costs to a proper appraisal of

accumulation at the production of consumer goods and to a correct computing of the consumption of raw and other material for investment purposes, and therefore to a correct determination of the part of national income assigned for investments. To illustrate this importance, let us cite the following example.

Until the year 1955 inclusively metallurgical products (including sheets) were -- as is known -- sold at prices below their prime costs. On the other hand the production of enameled sheet-metal articles and other consumer goods manufacuured from sheet metal showed accumulation. However the actual sum total of means accumulated by the state was smaller than the difference between the price-list value and the prime costs of these products. This was because a part of that difference had to be used to compensate for the losses sustained by metallurgical industry in selling its products at prices below their prime costs. The actual value of the means expended on investments was distorted both owing to above cited reason and owing to the difference existing between the value in sales prices and the prime costs of the metallurgical products used for investment purposes. This phenomenon was worsened by the fact that the prime costs of metallurgical products were improper because the prices of certain raw materials consumed by metallurgy also were lower than prime costs. It is clear that in such conditions the conduct of an analysis of economic activity was very aggravated.

Returning to the problem of determining prices according to the principles of direct or simple relationship, it should be remembered that this in turn breeds another problem: which prime cost should be the basis for price determination, mean weighted

cost of industry as a whole or prime cost of a plant selected as standard? With the prices of refractories as the example it was demonstrated that the sole correct solution is to use the costs of the plant selected as standard. However there arises still another problem, namely: should they be planned, resultant, or normed costs? As has been noted frequently throughout this book, normed costs are the best solution. However in practice this is not always feasible. The absence of data concerning technological standards often necessitates the adoption of planned or resultant costs instead of normed ones. In such cases the question concerning which costs will be better -- planned or resultant costs -- hinges on actual circumstances and on dexterity in calculating properly the planned costs. At any rate the latter solution is not satisfactory, and it is desirable to create conditions facilitating the use of normed costs as the basis for price determination.

Equivalent relationship is applied for determining prices in a totally different way. Here the question is not to create a proper relation between price level and cost level but to arrange prices so as to encourage purchasers to acquire chiefly those mutually replaceable raw and other materials whose production costs are lowest or which are the least scarce in national economy.

However it is to be emphasized that even the best determined prices of supply and investment goods have to be revised periodically. This is because of periodic changes in technological state of plants, machinery pool, and methods of production. All this causes changes in prime costs of production; the proportions among the unit costs of individual products tend to change and so does the profit level of the manufacture of these products.

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